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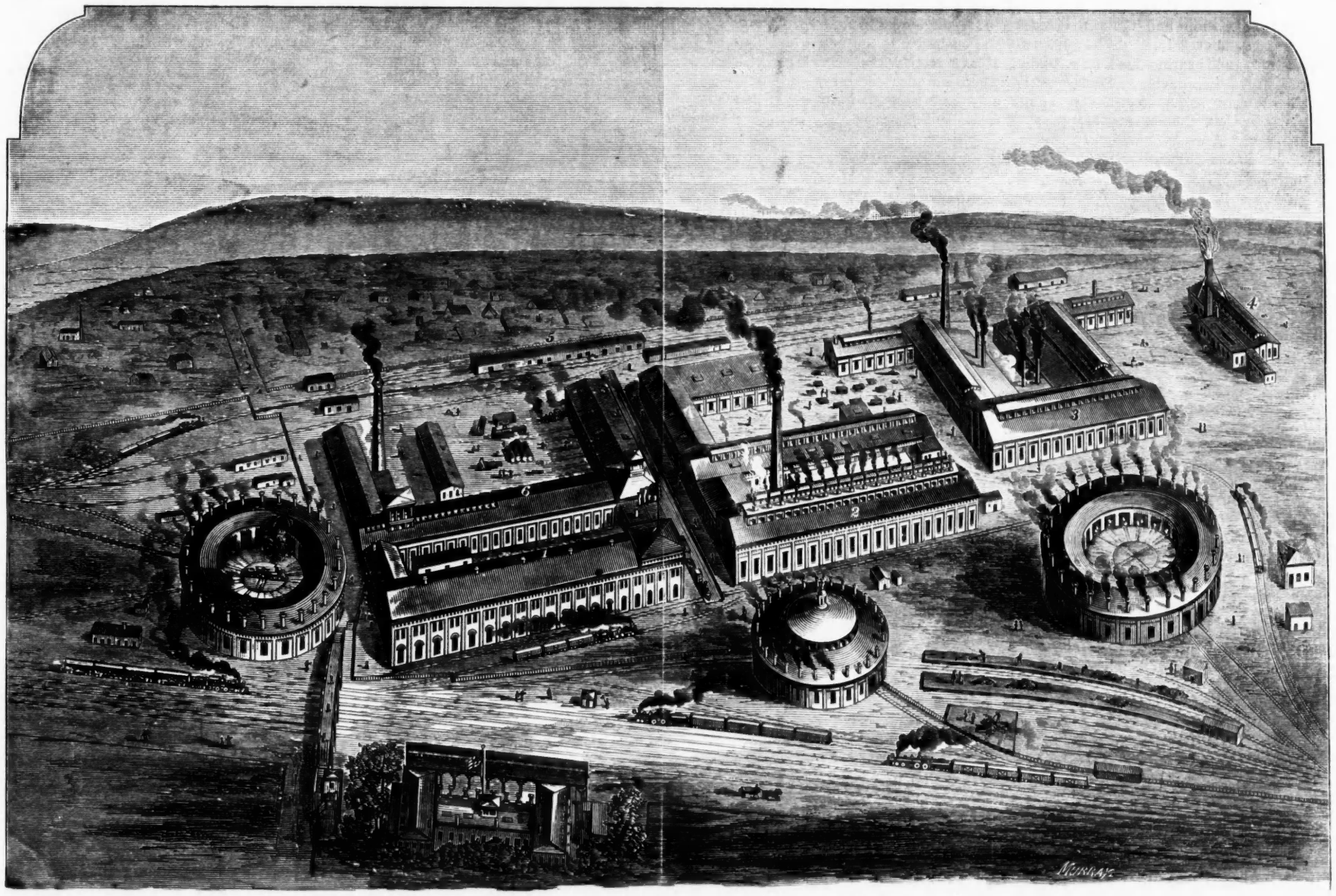


BIRDSEYE VIEW OF THE MOTIVE POWER SHOPS OF THE PENNSYLVANIA RAILROAD AT ALTOONA.

The Pennsylvania Railroad Shops at Altoona.

Altoona, Pa., which has been selected as the place for holding the midsummer meeting of the American Society of Mechanical Engineers, is essentially a railroad town. The city owes its existence to the Pennsylvania Railroad, having been built up around the immense locomotive and car shops of that company, which employs in one or another capacity about one-fourth of its entire population. The motive power shops—a birdseye view of which, sketched by our artist, is above presented, cover an area of 24½ acres, and have 9.93 acres of shop floor. The car shops, which are located about a mile further eastward, are the most extensive for building and repairing freight cars of any in this country, as well as having large capacity for turning out passenger cars. At the present time the Altoona shops employ in the aggregate nearly 4,500 men. Even with this working force they are unable to turn out cars and locomotives as fast as required, at the same time attending to all necessary repairing, and more shops are to be built, adjoining those now in use. The motive power shops are located immediately opposite the railroad station, on the main line of track, as shown in our view, which is taken from the north. The eastern round house (at the left) is 236 ft., the middle round house 195 ft. 3 in., and the western round house 300 ft. (less 4 in.) in diameter. As the visitor to these shops crosses the bridge from the station he comes first upon the "new erecting shop" (marked 1) at his right. This is 66 ft. 6 in. x 349 ft. 6 in., and has room for nine locomotives on each side. At the time of our recent visit eighteen locomotives were on the side tracks in process of repairing, besides two on the center track. Every facility seems to be provided for handling heavy work. A 25-ton traveling crane on each side, driven by a cotton rope, runs upon an elevated track, and is provided with crabs for raising or lowering. Pits extend below the floor along the whole length, on each side of the center track. In these are stored the parts of dismantled locomotives, when the boilers are sent to the boiler shop for repairs. In the winter the shop is heated by steam radiators in these pits. Boilers are here tested by hydraulic pressure, connection being made through a system of pipes to a Worthington pressure and force pump, or by steam pressure, 150 lbs. to the square inch.

The machine shop (marked 6), parallel with the new erecting shop, is 356 ft. x 85 ft. 6 in., two stories high. It is well lighted, and the upper floor is supported by two rows of cast iron columns, across which extend rolled iron beams. A track runs through the center of the ground floor, connecting with the tracks in the yard. A power crane travels on a single rail along the center of this track, driven by a rope. Stability is insured by a long carriage, and by stringers guiding the top of the crane post. Three large hydraulic elevators, at convenient intervals, raise and lower work from one floor to the other. The lower floor has two lines of shafting, and is provided with heavy tools, all of them grouped to occupy as little space as is consistent with convenience. An observer will notice no waste room. The planers are grouped in pairs, so that one man can attend to two at a time, if desired. The longest planer has a 24-foot bed, upon which the locomotive frames are planed their whole length with but one adjustment. We were also shown a lathe, in which the bed had been lengthened out from 24 feet to 32 feet, and the leading screw so nicely spliced by the foreman, without welding, that the joint was not visible.

Several of the planers have four tool holders, so that work can be planed upon the top, also upon both sides at the same time. Cupboards are arranged at intervals along the walls for the convenience of the men, for depositing tools, dinner pails, etc. One of the special tools is a vertical milling machine, the table of which moves in a rotary, horizontal, or almost any other direction desired. It can be used as a boring mill, a drill press or a milling machine, therefore it has a very wide capacity for finishing work.

The tool room, at one end of the shop, is conducted upon the check system. Each workman is provided with five or six brass checks, one of which he deposits when taking out a tool, and receives again when it is returned in good order. The taps, dies and reamers are made in the shop as required, except in case of extra demands, when some of them are purchased of manufacturers. U. S. Standard taps are made on a lathe, each of them with five flutes. They claim that these cut better and more regular than four-fluted taps. Those shown us were very well made, and drawn uniformly to a straw color. Very complete sets of plug and ring gauges and templates are here to be found. A Richards' measuring machine is used for obtain-

ing accurate dimensions. Work is done from templates and gauges rather than from detail drawings. This method operates most satisfactorily, and in the erecting shop pieces can almost always be relied upon to fit accurately.

The second floor of the machine shop is known as the vise shop, where the fitting up by hand and finishing of forgings and castings is done. A wing 126 feet long is also used as a vise shop. Emery wheels and grindstones are freely used in this department, the slow and laborious process of filing being employed only to a limited extent. By the aid of accurate templates and a well devised system of doing the work, this department is enabled to be run by comparatively unskilled men. The fitting done by the chisel and file, of course, requires men of special skill.

The "old erecting shop" crosses the end of the machine shop and the new erecting shop. It is 323 ft. 6 in. × 62 ft. 2 in., two stories high, and is surmounted by a belfry, as shown in the engraving. Three new locomotives were being erected here at the time of our visit. This shop is provided also contains four forges and a heating furnace. The finishing and mounting of wheels for locomotives and tenders, beside other work, is done in the wheel shop.

The main iron foundry (marked 3), 250x 100 ft., is a high and commodious building. It has two wings, one used for a wheel foundry, and the other for a core room. Each of these in turn has a wing—the brass foundry (on the west side), and the annealing ovens (on the east side). There are thirteen Sellers' hydraulic cranes used in the wheel foundry, which take up but little room and do the heavy handling expeditiously. There are four cupolas in use. Our space this week will not admit of a description of the arrangements and methods of doing work in the foundry.

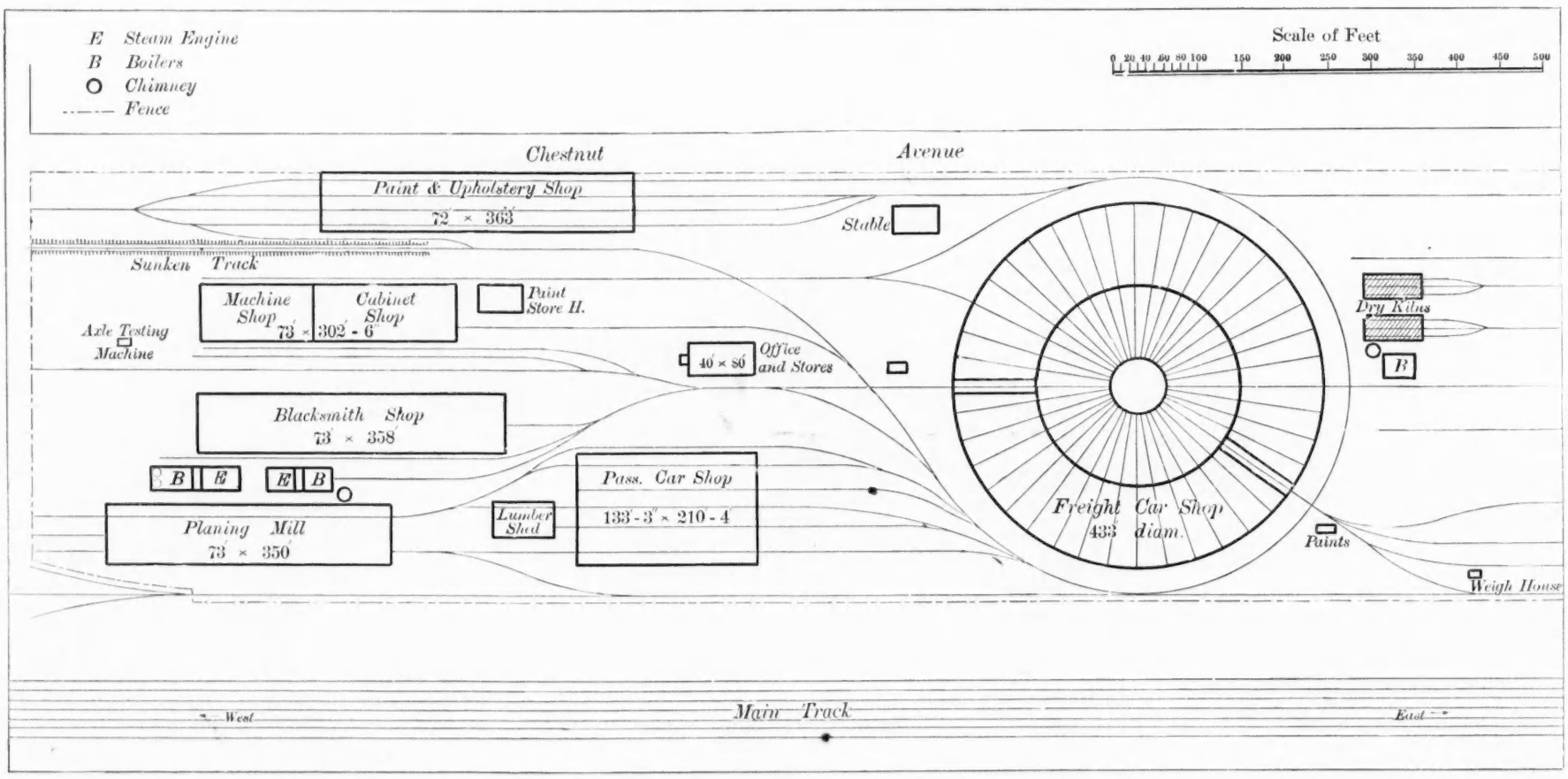
The paint shop (marked 5) is a wooden building, 346 ft. 6 in. long. Near the east end of this shop is the fire-engine house and the testing department. At the west end of the enclosure is the new wheel foundry (4), 165x65 feet, with two wings or additions. There are also several small buildings, used as store houses for patterns, boiler plates, tubes and other articles. In the foreground here and put together. There are 38 tracks converging to the turn-table in the center. Cars are made in lots of four each, and all transfers of material are made by locomotive, so that gangs of men are not required for lifting and carrying. The handling of material and parts of cars is done by ordinary laboring men, and skilled mechanics attend strictly to the kind of work where skill is needed.

In the blacksmith shop we noticed a large number of special formers in use for making forgings. When any considerable number of any one style of forging is required, a special former is generally made. This saves both time and money, and the plan is here carried out to an extreme.

In the passenger car shops we noticed several cars in course of construction of an improved style, which has been in use but a year or two. In this car the seats are lower and easier, giving more support to the body than in former styles. A new system of springs in the truck makes it ride more easily. These cars are all provided with Westinghouse air brakes and Janney couplers. All the passenger car springs are carefully tested, draw pay for the time spent in the shop Most of the men are employed by the day, but quite a number in the car shops are paid by the piece. The working time is 60 hours a week, or ten hours and ten minutes every day, except Saturday, when the time for closing is 5 o'clock. The time for dinner is fifty minutes.

The superintendent of motive power Theo. N. Ely, has his office at Altoona, from which he directs not only the shops at this point but the twenty-five other railroad shops scattered along the line of the Pennsylvania Road. A set of rules and regulations for the government of the Pennsylvania Railroad shops is sent out from the motive power department. We make the following extracts:

The shop bell will be rung each working day at ten minutes before the time specified for commencing work in the morning and afternoon, at which time the foremen and workmen must assemble; this will be the first bell; and the second bell, or bell for commencing work, will ring at the specified hours, at which time each foreman must know that all his men are ready to commence work. If they are not ready to commence work at the exact time, they may report themselves not less than five minutes before



Ground Plan of the Pennsylvania Railroad Car Shops at Altoona.

with heavy cranes and all facilities for performing the work required. In front of this shop is a pit thirty feet wide, extending the whole length of the shop, over which a steam transfer table runs upon two tracks. Locomotives are thereby quickly shifted to or from the boiler shop (marked 7) over any of the numerous tracks provided. Material is thus transferred between the blacksmith shop and erecting shop. The boiler shop is 126 ft. 6 in. × 70 ft., with a wing 206 feet long. It is divided into the erecting, the flanging, and the tank departments. There are three flanging forges, and a crane so situated as to swing from them all. Tanks are handled by differential pulley hoists run upon a track overhead. Both hand and machine riveting are employed.

The blacksmith shop (marked 2) is 345 ft. 6 in. long and 60 ft. wide, with an L 125x67 ft. There are 25 double forges four feet square, and seven steam hammers, two of 5,000 lbs., one of 2,000 lbs., two of 1,500 lbs., and one of 1,000 lbs. All but one of these hammers were made by Wm. Sellers & Co. There is also a shearing machine, which cuts up iron 4 inches square, and a large bolt heading machine.

The building in the rear, just beyond the one last-mentioned, is used for a blacksmith shop for 190 ft., and the remainder for a wheel shop. Here are twenty double forges and two 1,000 lb. steam hammers. A wing are a number of coal platforms. Near the eastern round house are the air brake shop, the sand house and the gas pump house.

Over two million pounds of iron castings, about 378,000 pounds of brass castings, and over a million pounds of bronze castings are made in the motive power shops every year. In 1880 they turned out 96,000 chilled car wheels. They are now repairing 15 engines a month, and will build 100 new engines this year. They also load up two supply cars a week, mostly with finished work, to send out along the line of the road.

At the time we visited the shops there were three of the new "Class K" engines (the first being known as "Long-Legged Ten") nearly ready to send out. In all, nine of these engines have been built. They have two pairs of 6½ feet drivers, 18x24 inch cylinders, and are provided with steam reversing gear. Each one weighs 82,700 pounds when empty, and 97,700 pounds loaded with water and coal. One of them recently made 65 miles in 60 minutes on a run between Philadelphia and New York.

The car shops, a ground plan of which appears on this page are of later construction than the locomotive shops. The large circular freight car shop is divided into three rooms—one for new work, one for repairs, and one for paint shop. There is no machinery in any of them, all the parts of cars being made in the other shops, assembled one by one; also one in ten of the freight car springs.

In the machine shop are a number of axle lathes, bolt cutters, and nut-tapping machines at work, two hydraulic wheel presses, also several lathes and upright drills, and a compound planer. We noticed some drill presses arranged in pairs, back to back, with a single cast iron brace running over the tops of the pair. This adds much to their stability and saves room.

In the yards 11,000,000 feet of lumber is usually kept on hand. The sunken track shown in the plan is very convenient in loading and unloading cars, as the floor of the car is on a level with the platform at the side.

In the month of June, 1881, there were made at these shops 517 freight cars and 12 passenger cars, besides reparing 2,100 freight cars and 44 passenger cars. Besides this, wheels and axles, platform work and couplers are sent out to various points on the line of the railroad.

A visitor cannot fail to be impressed with the smooth and practical system carried out in every part of the shops. Nowhere does there seem to be the least confusion or misunderstanding of what is required to be done. Every man is attentive to his work, apparently making it his chief object to produce satisfactory results, and not merely to put in the requisite number of hours and the next succeeding hour of the morning or afternoon's work, to the shop clerk at the office; and the foreman in charge may at his option name the hour for commencing work.

At the ringing of the second bell all entrances to the shops will be closed with but one exception, which shall be the main entrance, where a watchman will be placed to note the persons passing.

Workmen will be required to give their full time during working hours to the services of the company, and no portion of the time alloted to labor must be taken up in the manufacture or fitting up of fancy tools, washing up, or the reading of newspapers, books, etc.

No overtime must be made except by special order. Should the services of workmen be required for shop work, for more than the regular working hours, they will be allowed only the actual time made, and there will be no increase in the rate of pay over that fixed for regular working hours.

The foremen of the different departments must be at their places of duty during working hours, and see that perfect order is maintained and strict economy practiced; and they will be held responsible for the good management of their several departments, being careful that no time is idled away or material wasted by the workmen under their charge.

Each foreman will observe the time of his workmen and note all delinquencies, and must know personally that the time allowed each workman is only that to which he is justly entitled.

Each foreman will be held responsible for that portion of work committed to his charge, and see that no change in general or detail arrangement or painting of engines or

cars is made while under repairs at the shops, without special instructions; also for the strict performance of the duty of all workmen under his direction, and must see that the interests of the company are promoted, both as to the manner of performing the work and the quality of the same.

The machinery and tools of the shop must be kept clean and in order, all portable tools being returned to their proper places immediately after use.

No tools of any description whatever must be taken from engines or cars, or from the shops, or wherever they belong, unless by direction of the person having them in charge; and no workman must open the drawers or chests belonging to others without special permission from the owners or persons in whose keeping they may be.

The breaking or marring of tools or work will be considered as incompetency on the part of those employed.

All orders for work must come through the master mechanic, general foreman or foreman in charge. No "individual and company" work must be done except in cases of repairs to rolling stock used upon this road, and no material will be sold from the storehouses or shops without special orders from the general superintendent, superintendent of motive power, or the superintendent of the respective division.

The shop bell must be struck at each hour out of the working hours, and the watchman assigned to that duty must designate the hour by clear and distinct taps of the bell.

Visitors are allowed in the shops only by special permission, and must not interrupt the workmen in any manner.

Agents for books, papers, etc., will not be allowed to transact business in the shops or enclosures thereto; and railroad supply agents, inventors or patentees will not be allowed to occupy the time of the workmen.

No altercation with any person will be permitted, no matter what the provocation. Strict propriety of conduct and the avoidance of profane or indecent language is required, and all loud talking, laughing, singing, whistling, or anything that may detract from the good order of the shops, is prohibited.

Strict sobriety on the part of all the employes will be required, and those known to make daily use of intoxicating drinks will not be employed.

Smoking in the shops, or about the shops in the enclosures thereto, is positively prohibited under all circumstances.

The shops are provided with all necessary conveniences for workmen, such as closets, washing rooms (properly supplied), and ice water. Considerable pains have been taken to make the grounds around the shops attractive. Carefully trimmed grass plots are provided with beds of choice flowers, kept in the neatest order. This is an example worthy of imitation by many private shops.

Visitors are usually allowed passes to visit all the shops, there being no secret methods of doing work to protect from copying.

A regular fire brigade is kept under discipline, being drilled every Saturday. It consists of 84 men, including two chief engineers, two assistant engineers, and four foremen of companies. A steam fire engine and several chemical engines are employed. There are 22 fire alarm boxes, covering both car and locomotive shops.

Researches show that when the ancient mathematician, 1,000 years before the days of Euclid, computed the area of a circle, he *squared $\frac{8}{9}$ of the diameter*. Try it for an approximation.

A contemporary gravely discusses the theory of the bursting of water pipes from the freezing of their contents. We confess that our chief concern for the past few days has been how to get ice into the pipes. If the pipes won't stand it, "let 'em bust."

A recent English invention for a boring machine consists of a compound slide in the form of an inclined plane, the incline being in the direction of the length of the boring bar. By moving one part of the rest on the other the work is adjusted vertically.

A New Registering Gauge.

There is no question about the utility of a good registering gauge, and no doubt such gauges will come into much more general use if they can be furnished at a reasonable price, and of such construction as to be simple and durable, as well as accurate in their operation. The use of such a gauge, while it furnishes a means of determining if undue pressure is at any time allowed to accumulate in the boiler or boilers, is also of value in arriving at the most economical pressure of steam to be used for any purpose, and doubtless the record which it furnishes might advantageously form a part of that kept by every establishment using steam to any extent. The gauge herewith illustrated is said by the manufacturers to possess the essential features of such an instrument so far as simplicity, durability, and accuracy are concerned; and at the same time is furnished at a reasonable price. Referring to the engraving: it will be seen that the gauge proper, as well as the registering device, is contained in a case which is adapted to be fastened by screws to the wall—as in the counting room—and that the steam or water is connected as in the ordinary steam or water gauge. This case is of iron, finely japanned and ornamented, and so arranged that the register can be securely locked. The recording part of this instrument is a pressure gauge, of the well known "Bourdon" construction, which is provided with a pointer and dial, from which the pressure may be read in the ordinary manner. Near the extremity of this pointer one end of a light steel connection is attached, the other end of which is formed to receive the pencil which makes the records.

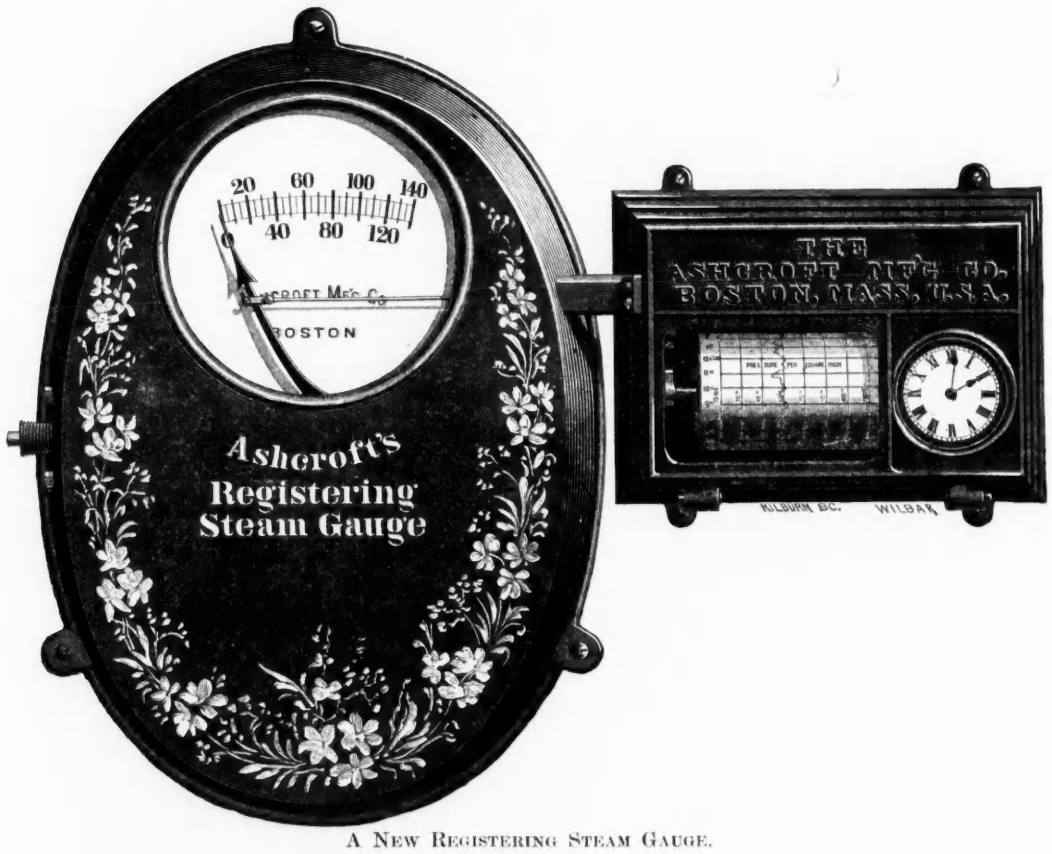
The pencil end of this connection traverses between guides to insure parallelism of motion, and is also adapted to be weighted just sufficiently to insure a legible mark. The registering part consists of a "Howard" clock, so connected to a light brass drum mounted in delicate bearings, as to cause it to make one revolution in twenty-four hours. The paper used upon this drum is made in pieces just sufficient to cover it, and is so ruled that when applied to the drum it will be divided circumferentially by lines representing hours, and longitudinally by lines representing pressures.

The pencil, as previously described, being weighted to keep it in contact with the paper, and moved along with the pointer in either direction as the pressure may rise or fall, while the drum revolves with the motion of the clock, records a line upon the surface of the paper from which the steam pressure and the time at which that pressure occurred may be read. One of these papers should be removed every twenty-four hours, dated and filed away for future reference, and a new one substituted.

These instruments when required can be furnished with a gauge upon each side of the drum, the pencils of which will respectively record upon one-half of its surface. In this way a single registering device can be made to answer for steam at different pressures, or for pressure and vacuum.

We are told that a number of these instruments are in use in large manufacturing concerns, and for registering the water pressure in the mains of city water works, &c.

They are manufactured by The Ashcroft Man'f'g Co., 111 Liberty St., New York.



A NEW REGISTERING STEAM GAUGE.

A Steam Engine Award.

It seems that award in the competitive steam engine test made at the Millers' Exposition at Cincinnati over a year ago, has at last been settled upon. It will be remembered that, of the five engines entered for the trial, two (the Brown and the Buckeye) were withdrawn, their builders not approving of the way in which the arrangements for the test were carried out. The conclusion is given as follows by the Cincinnati *Gazette:*

At the Millers' Exposition, held in this city in June, 1880, there was a spirited contest in regard to automatic cut off engines, no less than five entries being made for practical tests. These five were the Wheelock, Brown, Buckeye, Reynolds and Corliss. There was considerable interest manifested in this trial, and nearly all were anxious to have done with the wrangling, and have the cash or medal award made. About three weeks ago, J. W. Hill, a practical engineer of this city, submitted all the documents to Prof. Robert Grimshaw, of the Franklin Institute, who, after a thorough and exhaustive examination decided in favor of the Wheelock, and ordered the award made to him. The prize was $500 or a gold medal. Mr. Wheelock chose the latter, and he gets it, a beautiful one. The medal is a heavy solid gold one, weighing fifteen ounces. It is nearly four inches in diameter and a half inch in thickness. It is of fine gold and set with diamonds. On one side is the following:

"Awarded to Jerome Wheelock, in lieu of money premium, for the best automatic cut-off engine, tested June, 1880."

On the other side are the words, in raised letters, "First Millers' International Exposition."

One side is studded with diamonds, the other bears a millstone and regulators of silver, bevel wheel and pulley of bronze, and sickle of gold. The design and workmanship are exquisite.

The capacity of all the paper mills in the country is said to be 2,500 tons a day.

LETTERS FROM PRACTICAL MEN.

Machinists who Can't Read Drawings—Devices for Gear Cutting.

Editor American Machinist:

Notwithstanding "Chordal's" fluency of argument, it seems to me unsound practice to allow the incapacity of a newly-hired blockhead in the machine shop to influence the order, system, or rule of an establishment enough to compromise fixed methods or principles in its generating department. I would think it the foreman's duty to learn at once, upon setting a new man to work, whether he were competent to carry out the design for which he was hired, or whether he had but partly learned his craft, and must needs be watched and favored. When a person is engaged to work in a machine shop, and has "never seen a drawing," it is safe to conclude that he better not be trusted with anything requiring exactness, either of form or size, at first. I have never seen so cheap and poor a country shop that sketching to some extent was not used in directing workmen, and must say that the journeyman machinist who has not *seen* drawings, and to some degree been required to be guided by them, must be not only young in years, but in practice.

The reply of one of your correspondents to another (Mac) is quite pertinent; yet when he speaks of the excellent tools for gear cutting to be obtained, he reminds one forcibly of "Bob Ingersoll's" position on the question of training children: "Leave your pocket book where the children can go to it and take what they want." (Or words to that effect.) A man, receiving an income of $7.50 per week, may perhaps be excusable for disregarding Ingersoll's advice; and so, also, may a man struggling in a country place to establish a machine shop, be excusable for not procuring at once a gear cutter. Mac's method, to be sure, was most outragcously clumsy, but the expediency of adapting some means for cutting gears in a common lathe is by no means to be despised. In some future issue I shall be pleased to describe a contrivance I made use of at one time for the purpose, and with which I produced numerous very creditable jobs of gear and keyway cutting.

C. C. HILL.

Blackfoot, Idaho Ter.

Breaking of Annealed Steel.

Editor American Machinist:

To "Querist:" The large piece of steel packed with and surrounded by smaller ones, which were uninjured by annealing while *it* was apparently ruined, must have been either a different steel or had different treatment from the smaller pieces before annealing. If cut from the bar hot, it may have been heated to a "good mellow heat." Blacksmiths all know that steel cuts more easily in that condition, while but few are willing to do the hard work involved in working steel always at a proper heat. The fact that a large proportion of steel forging is done by men, a majority of whose time is spent in working iron, has probably much to do with steel being heated too hot for forging and annealing. As they become accustomed to the high color of iron at working and welding heat, with the ease with which it yields to the chisel or hammer and sledge, it is not strange that the highest heat admissible in working steel of high temper should seem to them not hot enough to work. As to 75 per cent. of twist drills breaking in the center or a great distance back from the cutting lips, my experience leads me to think that a great deal more than 75 per cent. break at another place, *i. e.*, at or very near the point, which, on general principles, is where they should break, as being thinner and in immediate contact with the resistance which causes the breakage. Torsional strain breaks the drill of course. But why does it sometimes break at a part far removed from the point of contact, and at a thicker part of the drill, with the breaking part in its generally supposed strongest condition (soft)? And what will prevent it? These are the questions I tried to answer in the letter to which "Querist" refers, not because the twist drill should of necessity have different treatment from other tools, but because having broken in that way it afforded an illustration.

Pittsburgh, Pa. S. W. GOODYEAR.

New Slide Valve.

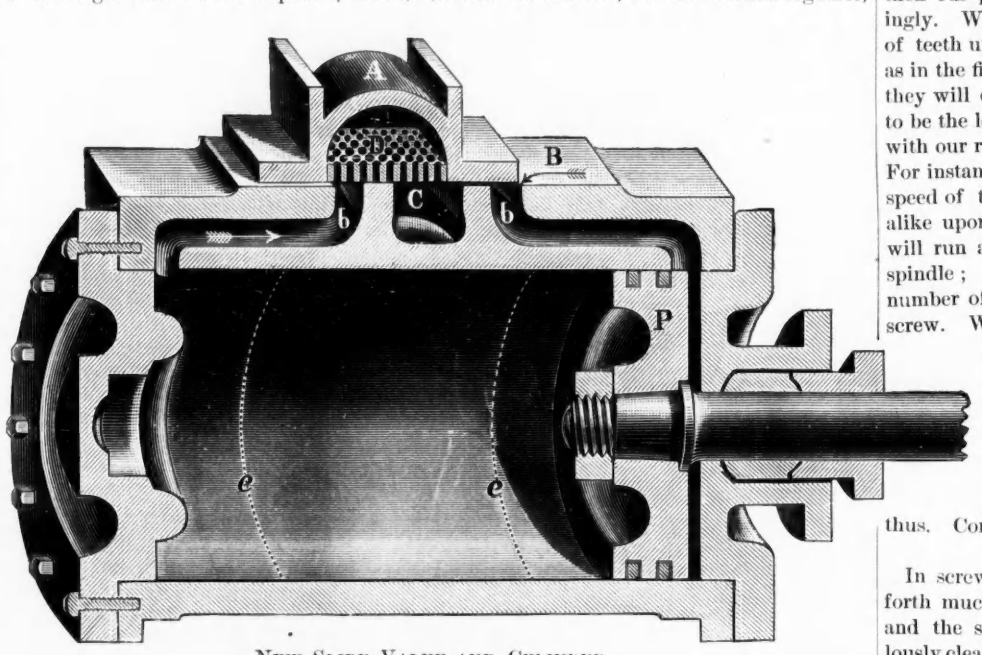
The accompanying engraving represents a slide valve designed to deaden the noise caused by the escape of exhaust steam from the cylinders of locomotives upon the elevated railroads in New York City, which has been a constant source of complaint since the roads started. The valve *A* here shown is constructed the same as a plain D-slide valve externally; but the cavity, instead of being open as in ordinary slide valves, is covered by a perforated plate *D*, cast solid with the valve. This plate, in a valve used upon an engine belonging to the elevated roads with cylinders 14″×19″, has 500 holes of $\frac{3}{16}$″ diameter in each valve, compelling the steam to pass from the steam ports *b b* into the cavity of the valve, from thence again through the holes to the exhaust cavity *C*. It is claimed that the noise is produced at this locality, therefore here is the proper place to cure it. Several attempts have been made to do away with the noise made by the engines of the elevated roads, by means of mufflers of netting in the smoke box, or a series of tubes and reservoirs attached to the steam chests and exhaust pipes. The former becomes choked up in a few days by the grease from the cylinders and sediment or foam from the boiler, which, coming in contact with the ashes and hot netting, forms a coating which is not easily removed. As soon as the holes become stopped an excessive back pressure is caused and the engine will not run. The latter causes a like result.

In the trials made with the improved valve thus far, the holes in the valve have not become obstructed or choked. The cause of the noise alluded to is claimed to be the sudden and too early exhaust. Therefore the introduction of the perforated plate *D* prevents a too sudden release, and lets it go gradually, since there is said to be plenty of time to admit of this without causing an excessive back pressure. This is accomplished by taking advantage of the too early exhaust that exists with the link motion when cutting off short, which causes an extravagant consumption of fuel.

When outside lap and lead are given to a valve so as to work the steam expansively, the exhaust opening is equal to the lap and the lead when the lever is placed to allow the valve full travel. The lead increases as the lever is pulled up to cut off shorter, or in other words, if the valve has $\frac{3}{8}$ inch outside and no inside lap, and $\frac{1}{16}$ inch lead, when the lever is pulled up to cut off short, the lead will be increased to, say $\frac{5}{16}$ inch, which will leave the exhaust port open $\frac{5}{16}$ inch before the piston begins its return stroke, or while the piston is traveling from *e* to the end of stroke; and as it takes time for the valve to travel $\frac{5}{16}$ inch, it will be found that the exhaust port begins to open far too soon for the steam to have given out all the power it might have done had it been detained a little longer. This is accomplished by the valve here shown, and has a different effect from inside lap, which causes a too early compression, an evil to be avoided.

The inventor claims with this valve to take advantage of the too early exhaust in reducing the noise, and of too early compression in adding to the power of the engine. By preventing a too sudden exhaust the fire is not cut or torn to pieces, as with the common slide valve, where a large portion of unconsumed fuel is thrown out of the smoke stack, while a large quantity is sifted through the grate by the violent agitation of the fire. With the new valve the draft is more steady, and is not as violent, which gives the gases more time to ignite and consume, thus effecting a great saving in fuel. The nozzles are taken from the exhaust pipes, and there is no fire thrown from the smoke stack. These valves are now used upon twelve engines running upon the Manhattan Elevated Railroad. At high speed, and cutting off short, the back pressure is somewhat increased, but not to an extent to overcome the other advantages derived from its use.

These valves are made by W. S. Hughes, Long Island City, N. Y.

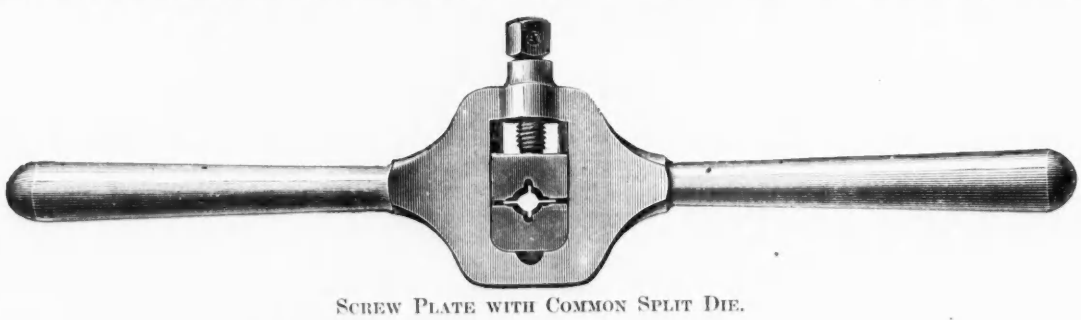


New Slide Valve and Cylinder.

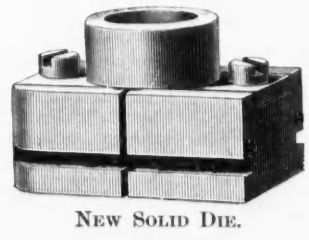
The Two Forms of Threading Dies.

The first form of threading dies is presumed to have been the common split die, worked in a plate on the principle of the one shown in the first cut herewith. The peculiarity of this die is that it commences its cut on the outside diameter of the bolt, the dies being closed as the cutting proceeds. In cutting the thread in this form of die, the hub, or master tap, is made twice the depth of the thread larger than the size required; that is, a half-inch 13 threaded die would be cut with a hub six-tenths of an inch in diameter, the depth of a 13 thread of the Franklin Institute Standard, being five-one-hundredths of an inch. This doubled gives the one-tenth of an inch added. The reasons are that the dies are opened to commence their cut on the outside diameter of the bolt. This method gives the nearest correct angle of thread to commence their cut, and also avoids the bottoming of the thread when desirable to cut below the given size, thus securing a larger range of sizes. Its great range of sizes and ready adaptations in repairs are its chief advantages. This class of tools are made in six sizes by the Morse Twist Drill and Machine Co., and cover a range from $\frac{1}{16}$″ to 2″. In the present state of the art, where the size of the bolt is the unknown quantity, they seem to be a necessity. Its disadvantages are that the die has to be run over the work several times. To obviate this the form of die shown in the second cut was devised. This die is constructed on the principle of a solid die being threaded by a hub the diameter of the bolt required. It finishes its work at one cut. In the several styles of dies of this class in use, there are various devices to adjust them limitedly to conform to slight variations in the size of the taps, and to compensate for wear. In the die shown the adjustment is made by the two small screws, which hold the dies to any position to which they are adjusted. It is not well to attempt too great a variation in size, as the proper angles of threads are only found when the die cuts the size of the hub by which it was threaded. Much variation from this tends to shear the sides of the threads, and to destroy their strength and accuracy.

The point to keep in mind, when making or ordering hubs for dies, is that all dies that finish their work at once, by passing *over* it, are classed as *solid* dies, and should be cut by a hub the diameter of the bolt required; while such dies as commence their cut on the *outside* of the bolt, and are worked together, as the cut shows, belong to the *split* die class, and should be cut by a hub twice the depth of the thread added to the required bolt.



Screw Plate with Common Split Die.



New Solid Die.

Screw Cutting on the Engine Lathe.

No. 2.

By Frank H. Richards.

To find the gears to cut any thread, we select any gear for trial and make the number of its teeth the third term of a simple proportion. Make the thread of the leading screw the first term, and the thread we wish to cut the second; then multipyling the second and third terms together and dividing by the first gives us the fourth term, or the gear to place upon the screw.

Say that our lathe screw is 4 and we wish to cut 12, we select 25 for the gear to use on the spindle. Then

4 : 12 : : 25 : the gear to place on the screw,
(12×25)÷4=75,
4 : 12 : : 25 : 75.

If we find we have no gear of 75 teeth we must try again, selecting some other gear for the spindle. Thus

4 : 12 : : 32 gear required,
12×32=384, 384÷4=96,
4 : 12 : : 32 : 96.

In this case that we have been computing, the thread of the lead screw is to the thread we wish to cut as 1 to 3, consequently any gears bearing the ratio 1 to 3 would have answered our purpose. By bearing in mind the principles of proportion we can readily compute any thread; and if at all expert with figures it may usually be done "in the head," and almost instantly.

If we have certain gears upon the lathe and wish to know what thread they will cut, we make the thread of the lead screw the third term, the gear on the spindle the first term, and the gear on the screw the second. Say that our lead screw is 5 to the inch, and we have on the spindle 45, and on the screw 63, then

45 : 63 : : 5 : gear required,
63×5=315, 315÷45=7,
45 : 63 : : 5 : 7.

In many lathes the stud or spindle which carries the driving gear for screw cutting runs at a different speed from that of the main spindle—often one-half or one-third—then our practice must be modified accordingly. We place gears of the same number of teeth upon both the stud and lead screw, as in the first instance, and note what thread they will cut; then considering that thread to be the lead of the lathe screw, we proceed with our rule of simple proportion as before. For instance, if the stud runs at one-half the speed of the lathe spindle, then with gears alike upon the stud and the screw, the screw will run at one-half the speed of the lathe spindle; the lathe will cut double the number of threads to the inch of the lead screw. We then in our computations for this lathe make this double number the first term of our proportion, and proceed as before. If the lead screw is 4 and geared 2 to 1, we call it 8, and everything comes right. Suppose we wish to cut 10 to the inch upon a lathe geared thus. Computing in this manner we find

8 : 10 : : 40 : 50.

In screw cutting the rest moves back and forth much more than in ordinary turning, and the slides should therefore be scrupulously cleaned, and kept clean, and should be thoroughly and frequently oiled; and it should be seen that there is no possibility of anything catching or interfering with the travel of the rest. It must also be remembered that some of the actual cutting force of the tool is to be overcome by the lead screw and the gears which drive it. Thus, in cutting a screw of a pitch so great that the thread forms an angle of 45° with the length of the screw—as I have more than once had to do in practice—one-half of the cutting force of the tool, besides the friction of the rest upon the slides, is to be overcome by the lead screw, and proportionately for any other pitch; so that it is a safe practice, if there are two or more sets of gears which will cut the desired thread, to select the largest, and thus reduce the strain upon their teeth and the leverage upon the studs as much as possible.

Compound Gears.

Suppose we wish to cut a thread so coarse or so fine that we have not the gears that will give us the desired movement. We then have recourse to what we familiarly call "compound gears;" that is, substantially, we make our intermediate gears do us service in modifying the motion of the screw. Having a lead screw 4 to the inch, suppose we wish to cut 30. By simple proportion we have

4 : 30 :: 20 : 150

But we have no gear with 150 teeth, and we cannot well use one with less than 20. Suppose, then, that we first find gears that will cut 15 to the inch—one-half of 30.

4 : 15 :: 20 : 75

If, now, in transmitting the motion from the stud gear to the screw gear, we can make the intermediate give-off to the screw gear just one-half the movement it receives from the spindle gear, we readily accomplish our purpose. Upon the stud which carries the intermediate gear we place two gears side by side, and made to turn together by a feather on the sleeve which carries them, one of which gears has just twice as many teeth as the other—say, 72 and 36. Then connecting the gear upon the spindle with the larger of these gears, and the gear upon the screw with the smaller, we find that we cut the thread desired.

While this is perhaps the simplest way to

explain the operation of compound gears, it is not precisely the way to most readily find them. The intermediate gears are no longer properly intermediates, but one is driven and the other is a driver, and we compute compound gears by grouping together the drivers in one term, and the driven gears in another, considering each group as a single gear. Our proportion for cutting 30 threads will then stand like this:

Drivers. Driven.

$$4 : 30 :: \binom{20}{36} : \binom{75}{72}$$

The gear 20 on the spindle is a driver, 72 on the intermediate stud is driven; 36 on the stud is a driver, and 75 on the screw is driven.

To find compound gears for any thread, then, we first select two gears for drivers, bearing in mind that if we wish to cut a very fine thread they will be small, and if we wish to cut a coarse thread they will be large, and we make these gears the third term of our proportion. Let us try to cut 36 to the inch:

$$4 : 36 : : \binom{20}{24} : \text{Gears required;}$$

then $20 \times 24 \times 36 \div 4 = 4320$

and $4 : 36 : : \binom{20}{24} : 4320$

We want, then, for our driven gears two whose product shall be 4320. It will help us in finding these to remember the factors which produced this number. We select 72 as one of these gears, then $4320 \div 72 = 60$, the other gear. We then have our proportion complete:

$$4 : 36 : : \binom{20}{24} : \binom{72}{60}$$

Cancellation will vastly simplify all these operations. Any treatise on arithmetic will teach that it does not come within the limits of my undertaking. I, however, give a single instance. Taking our proportion as above:

$$4 : 36 : : \binom{20}{24} : \text{Gears required.}$$

Dividing the first and second terms by the same number, 4:

$$1 : 9 : : \binom{20}{24} : \text{Gears required.}$$

Resolving the second term into its factors:

$$1 : 3 \times 3 : : \binom{20}{24} : \text{Gears required.}$$

Multiplying the second and third terms together:

$$1 : 3 \times 3 : : \binom{20}{24} : \begin{matrix} 20 \times 3 = 60 \\ 24 \times 3 = 72 \end{matrix}$$

This operation any machinist should be able to perform without the help of a pencil.

Sketch of the Life and Work of W. S. Hudson.

William Smith Hudson, the subject of this sketch, died at his residence in Haledon, near Paterson, N. J., July 20, 1881, at the age of seventy-two. He was born in Derbyshire, England, on the outskirts of the town of Derby, where his parents owned a farm, and received his education at the Quaker School. After finishing his education, he, according to the wishes of his parents, learned the grocery business. But nature had developed in his mind a taste for mechanics, and in the midst of the work of doing up parcels he would be actively engaged with mathematical problems and ideas in connection with steam engines and machinery.

Discontented with the pursuit chosen for him by his parents, he resolved to leave it at once, and therefore applied for a situation under the instruction of George Stephenson, the eminent engineer who designed and built the first successful locomotive.

The shop where he learned his trade was at Nottingham, and he lost no time in gaining information in the different branches of the engineering profession. Possessing an excellent memory and a firm determination, he became master of his business, and in 1835 came to this country.

The first engagement of the young man was with the Troy and Saratoga Railroad as locomotive engineer, where he remained but a short time, afterwards going to Rochester and running as engineer upon the road between that city and Buffalo.

He was solicited to fill the position of engineer at the Auburn State Prison, but was offered only a low salary, as his general appearance at this time was very much against him. He stooped somewhat in his walk, and appeared quite young and inexperienced. But when he named the salary required, and firmly declared that he would not take the position unless it was paid, the authorities changed their opinion and concluded to engage the young man at once. During the eleven years he remained in Auburn he became a sort of designing and constructing engineer, and built two locomotives, which were very successful, besides a promiscuous lot of machinery. But the difficulty of obtaining and keeping skilled labor made him resolve to leave the situation.

He next accepted a situation as master mechanic of the Attica and Buffalo Railroad, where he remained three years. While in the latter position, he became acquainted with the proprietors of the Rogers Locomotive Works, who offered him a position as superintendent of that establishment. He accepted the offer, and removed to Paterson in 1852, the firm name then being Rogers,

William Smith Hudson.

Ketchum & Grosvenor. It was changed in 1856 to the Rogers Locomotive and Machine Works, when Mr. Hudson was reappointed mechanical engineer and superintendent, which position he held until his death. He was a very quiet, unassuming man, an excellent, skilled engineer and mechanic, devoting most of his time strictly to business, and was well versed in the modern methods of handling mechanical problems in emergencies. In consequence of his excellent memory, he retained a knowledge of nearly everything he read, and was often consulted for information on obscure and difficult subjects. Some of his friends used to call him a walking encyclopædia, as he never said "I don't know" when asked a question relating to his business, but made it a habit to be informed.

He took out about a dozen patents, most of which were assigned to the company by which he was employed.

In 1850 he invented the application of cast iron thimbles to the ends of boiler tubes to keep them from leaking. At that time brass or copper tubes were used, which, owing to the difference in expansion between the tubes and flue sheet, were almost constantly leaking. Wrought iron thimbles were tried, but it was found that they would also leak, until, finally, it was suggested by Mr. Hudson to use cast iron thimbles instead of wrought iron. This innovation was warranted by the following experiment: A cast iron thimble was turned to a gauge, also one of wrought iron, both of which were heated red hot, and cooled in water. This operation was repeated a dozen times or more, careful measurements being taken each time. The results showed the wrought iron thimble to be less in diameter, while the cast iron was larger. The cast iron thimbles were then generally adopted—with success, and they are still used in the furnace end of boilers having brass or copper tubes.

Another of his inventions was a diaphragm, or baffle plate, placed in the smoke box, about 7″ to 10″ in front of the tubes, for the purpose of turning the course of the products of combustion downwards as they came from the tubes. The diaphragm being in two pieces, the lower part could be adjusted up and down by means of bolts, so that the draft could be regulated to keep all the tubes clean. This, of course, created a better heating surface, and effected a saving in fuel, and had the effect of breaking up the sparks. It was also intended to do away with the petticoat pipe, as it possessed equal mechanical advantages. This diaphragm is now used in the long smoke boxes of the locomotives built under the Railway Combustion Co.'s patents.

The Bissell patent truck had the frame pivoted rigidly to the frame at the back end, so that, should the truck leave the track, it would be slued across the engine, thereby rendering it very dangerous; moreover, the back boxes were rapidly worn away, as the truck had a limited motion. Mr. Hudson introduced a radius bar, running from the saddle to the middle of the truck frame, which allowed the truck to follow any curve, permitting an uninterrupted movement of the truck in passing around curves. This improvement made a perfect success of a patent, which was worthless before its application. The plan of equalizing the weight upon the truck now used upon the mogul and consolidation locomotives was also invented by Mr. Hudson. Before this was done there was danger of the weight becoming so unequally distributed that the truck would be lifted from or jump the track in passing around curves. The weight was equalized in two ways: one of which was to suspend a cross beam from the front end of the forward equalizing beams, and placing one end of a lever at the center of this beam; while the other was attached to a spring upon the center bearing of the truck, while the fulcrum was bolted to the bottom of the saddle. The other method was by bolting pockets to the sides of the smoke box and inserting equalizing bars, one end of each resting upon the springs of the truck, while the other end was attached to the forward equalizers. It will be observed that the former was for a center bearing, and the latter for a side bearing truck.

The double end engine is another of the inventions of Mr. Hudson. It had two pairs of driving wheels with a truck having a single pair of wheels at the cylinder end, also one of the same under the foot board. These locomotives were built to run either end foremost for short, rapid transit. The locomotives used upon the Second and Sixth Avenue Elevated Railroads in New York City are constructed upon this plan, and are exceedingly flexible in passing around short curves.

These locomotives do well in service, two of them 15″ × 22″, with 5 ft. driving wheels, having run during the past Winter upon the Illinois Central Railroad when other locomotives failed, by reason of the severe weather. These engines, in some cases, were built with a four-wheeled truck under the foot board, when the tank and coal box had to be large for running longer distances. They generally have the equalizing device described for side bearings, which offers very little frictional resistance in passing around short curves. The double ender, without this device, would be an entire failure.

Another of his inventions was the spiral cone and spark arrester now used upon the Rogers locomotives, which causes the products of combustion to move in a spiral course as they reach the cone which breaks the sparks and prevents throwing fire. A rocking grate was applied to some engines, in which the cast iron bars rested upon two shafts running lengthwise of the fire box. Upon the shafts were double arms, so that by giving a short reciprocating rotary motion to them, the grate bars would each be raised and lowered alternately, the vertical movement breaking up the clinkers.

Among other inventions may be mentioned –improvements in safety valves; rolling tube sheets; improvements in levers; improved tank locomotive, and a compound locomotive, as well as others, which he worked out aided by his subordinates.

Mr. Hudson was married shortly after his arrival in this country. The family consisted of three daughters and one son. The son served during the war of the Rebellion, and has since died. Two daughters have also died, leaving only the widow and one daughter now living. Although but little known publicly, Mr. Hudson had an extensive circle of private acquaintances, who deeply mourn his loss.

Cutting and Drilling Glass.

The latest tool for cutting holes in glass is said to be a thin German silver disc, impregnated with diamond dust. For drilling holes, cylinders similarly impregnated are used. These tools are said to cut very rapidly, and to show little or no wear from use.

A Big Day's Work.

On Friday, July 29, the Chicago, St. Louis and New Orleans Railroad changed the gauge of their road between Cairo and New Orleans from 5 feet to 4 feet 8½″. The distance is 571 miles, and the work was done between daylight and 3 P. M.

C. E. Simonds, whose communications have frequently appeared in the American Machinist, has accepted a position as draughtsman with the firm of Grant & Bogert, machine tool makers, at Flushing, L. I.

Extracts from Chordal's Letters.

HOW TO DEFINE SPIRALS—PITCH OF SCREWS, PROPELLERS AND SPIRALS—ANGLES AND PITCHES OF SCREWS.

Editors American Machinist:

* * * * In my last letter I referred to the spiral flutes in grinding rolls, and stated that some way of describing the spiral, which would at once convey intelligence to the miller who wants the spiral flute, and to the machinist who cuts the spiral flute, would be found useful when millers begin to get as particular about roll dresses as they are about stone dresses.

* * * * A miller orders "fluted rolls eight inches diameter, two feet long, fluted with V-shaped teeth, twenty to the inch, flutes to be cut spiral twenty degrees, same direction of spiral on each roll."

Now, what does this miller mean by "cut spiral twenty degrees?" Nobody knows but the miller who gave the order.

You ask him what he means, and he says he means simply what he says; that there is to be a divergence of twenty degrees between the spiral flutes and a line representing a straight flute. You understand this well enough, and go ahead with the fluting.

Pretty soon you get an order from another miller—flutes to be cut spiral twenty degrees. You ask him what he means, and he says he means what he says; the flutes are to twist twenty degrees of the roll circle in the length of the roll. You understand this, and go ahead with the fluting.

The next man orders a roll cut with a spiral of ten feet pitch. You understand this without questioning, and go ahead with the fluting.

The next order specifies: the flutes to be spiral two inches in the length of the roll. This is easily understood.

Next comes an order: flutes to be spiral one inch and a half to the foot. This is easily understood.

Another wants the flute to twist the width of ten flutes in going the length of the roll.

* * * * Here are several common methods of defining the degree of spirality, some sufficient in themselves, some requiring explanation.

* * * * A spiral is a line traced upon a revolving cylinder by a longitudinally progressing point. For examples we have the thread of a common screw, the periphery of a propeller blade, the rifle of a gun, the groove in a twist drill, spiral spring, and the teeth of helical gearing.

* * * * The degree of spirality of a screw thread is always indicated by distance progressed during one revolution, properly mentioned as the "pitch" of the thread; as a tenth of an inch pitch, or, in the language of the shop, as "ten to the inch." A certain very ignorant class speak of a "number ten tap."

* * * * The word "pitch" is not intelligibly understood by many shopmen when used to express distance between points. We have the pitch of threads, the pitch of rivets, the pitch of joist, the pitch of gear teeth. Let it be considered that something is to be moved a distance by means of a succession of short tosses or pitches, and the applicability of the word will at once appear.

* * * * We always define a screw thread by its pitch, but in certain cases there is a chance for misunderstanding. A square thread of a quarter-inch pitch, or four to the inch, is to be cut on a half-inch bar. Such a thread would call for a groove one-eighth inch wide, cut one-eighth inch deep. This would cut the bar half in two, and leave but a weak central core.

To get a stronger core, while retaining the same pitch of thread, resort is had to cutting a groove a sixteenth wide and deep, and then cutting a similar groove between the ones just formed. This gives us the "double thread screw," which has no peculiar properties, except that due to a shallow thread.

In some rare cases circumstances may force us to cut a triple or even a quadruple thread, when, if the piece would be strong enough, we would cut but a single one, the pitch being the same under all circumstances.

Now the question arises: What is the pitch of such a double-threaded arrangement? The pitch of the spiral is, of course, a quarter of an inch, but the pitch of the thread is obviously an eighth of an inch. The spiral is four to the inch; the threads are eight to the inch.

* * * * Machine tool shops deal considerably with double and triple threads. All machine tool shops use drawings and systems and what not. I do not know what the general practice is in such shops when they come to drawings of such screws. In my own practice on such work I have written on the drawing: "Double square thread—three to the inch." I never knew of any trouble from such drawing, but I saw that the matter was helped by the existence of certain taps which such screws were to suit. In view of new sizes, I changed to "Square thread—three to the inch—cut double." This didn't look right, and after a while I changed to: "One-third of an inch pitch—cut double—square thread." I can't see that this is any better. I wanted a spiral of a third of an inch pitch, and, so far as the above specifications are concerned, a workman is justified in cutting the *spiral* one and a half-inch pitch, which is not what I wanted, but is just what I called for, viz.: a *thread* three to the inch, or one-third inch pitch.

I have never heard of any trouble in regard to such matters, and for that reason I never supposed any one had contrived a brief and simple expression which would cover the ground with certainty.

I have no suggestions to offer, as the subject might be a useful one for discussion among your practical correspondents.

* * * * The propeller screw of a vessel is simply a very short section of a two or three or four threaded screw, and its degree of spirality is always expressed as the pitch of one of the threads.

The degree of spirality in rifling is expressed by inches pitch of the twist, thus: "twenty-two inch twist."

In some rifling the twist starts easy and gets quicker toward the muzzle of the gun. This is called a "gain twist," and its degree at each terminal of a length must be given, the twist always being defined by its pitch.

In the Morse twist drills the spiral, commencing at the drill point, gets less in degree towards the shank. They call this an "increased twist," the propriety of which expression depends largely upon which end of the drill you commence to talk about first. The degree of this increase twist is expressed the same as in rifling, that is by the pitch of a given length.

When the spirality of a wire spring is defined, which is but seldom, it is generally done by specifying the diameter of the wire, and the space between coils. These added together would determine the pitch, but the spring maker don't *think* pitch at all. He simply takes the specified size of wire, and winds it with the specified space between. Very small springs are spoken of as so many turns to the inch.

In helical gearing, a rarely used device for transmitting rotary motion between two shafts not parallel, and not in the same plane, the spirality of the teeth is defined by the pitch of the spiral.

The worming of feed rolls in fabric mills, by winding a tape upon them, is generally described by giving the width of tape and the distance between turns.

* * * * Let it be noticed that the only use ever found for the thread of a screw is to produce longitudinal motion during rotation. All we want to know is how far something will move during one revolution. The pitch of the spiral thread tells us this at once.

We can think pitch and think intelligently. In a propeller screw we have the same conditions. The pitch gives us an idea at once of the advance per revolution.

In the rifle we have the same conditions reversed. The pitch of the rifle tells us how far we must travel to produce one revolution. The word pitch conveys this idea at once.

In spiral springs we deal with new conditions. Nothing revolves, and we don't care what the pitch is, except for purposes of manufacture. To say that a spiral spring has a half inch pitch would convey no idea of any quality of the spring to our minds. The spirality of a spring is not a functional quality of a spring, and is secondary in every way.

* * * * All spiral cutting machinery is adjustable with reference to the pitch of the spiral, just like screw cutting on an engine lathe. The gear tables are arranged in the same manner, and tell us what gears to put on to cut certain pitches of spiral.

* * * * The pitch seems to be the essential quality measurable in a spiral. It seems the proper handle to take hold of. It tells us what the spiral will do, and it tells the spiral maker at once what is wanted. The pitch of a spiral is independent of any other quality. When we think of a spiral we think of its advance during rotation—we think *pitch*. These facts might lead us to ask–why, in the name of common sense, the grist mill man can't tell us the pitch of his spiral flutes and be done with it?

* * * * The pitch of the spiral of a mill roll is no more a quality than in a spiral spring. The mill man don't care about the pitch—don't think pitch;—he thinks of the angle of the flute caused by its spirality.

* * * * Diameter does not affect the pitch of a spiral, but it does affect the angle.

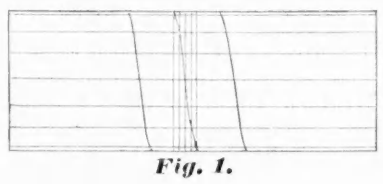


Fig. 1.

Here in Fig. 1 we have one-fourth inch pitch, or four threads to the inch, cut on a three-quarter inch bar, and here in Fig. 2 we

Fig. 2.

have the same spiral or thread cut on a one-eighth inch bar. As *screws* or *pitches* they are the same exactly, but behold the angle of the threads, and see how much steeper a lessening of diameter makes a spiral.

It is with this angularity that the mill man has to do, and we can at once see why he cannot *think* in pitches.

* * * * Our school books tell us that a screw is simply a rotary wedge—an inclined plain wrapped around a cylinder. They explained to us how we gain advantage by wedges, &c.

* * * * Every machinist in his early studies quickly tumbles upon an apparent fallacy in this screw business. He unwinds the inclined planes from two screws of the same pitch, and this is what he gets.

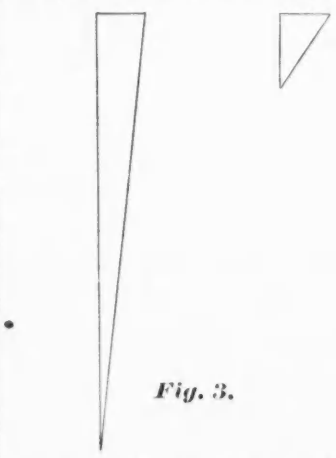


Fig. 3.

These two "wedges" are exactly what develop from unwrapping the screws shown in Figs. 1 and 2. The said inquiring machinist immediately asks if the big screw don't have the most power, using the same lever to turn it, and he points to these two wedges. What is the explanation?

* * * * To return to the mill rolls. Let the mill man determine on the angle he wants, on the diameter of roll, &c., and then figure out the pitch of the spiral. There are easy ways of doing it, and much trouble and time can be saved by doing it.

* * * * *

Very respectfully,

CHORDAL.

Shop Kinks.

No. 12.

PACKINGS FOR HYDRAULIC WHEEL PRESSES.

By L. F. Lyne.

Numerous questions have been sent to the American Machinist from time to time, by persons who have had more or less trouble with leather hydraulic packings used in wheel presses for railroad shops and other places where similar work is done.

I am therefore moved to a few suggestions and "bits of experience" upon the subject, as the persons seeking information have no means of informing themselves upon this subject, except by their own experience, unless they happen to accidentally meet some one who practically understands the case.

The packings generally used for the rams of wheel presses are made of leather, similar in shape to that shown at *c c*, in Fig. 1 of the accompanying engravings. A section of this packing is shown in Fig. 3, the circles being struck from the center *k*, which form I have found to give good satisfaction in practice. One of these packings has been constantly used for over five years in a wheel press doing general wheel work.

In this case the packing groove in the casting was $\frac{3}{4}''$ deep and $\frac{1}{8}''$ wide, the side towards *a a* being rounded to a true circle. A piece of the best oak-tanned sole leather of sufficient size for the packing was selected from the back of a hide, and was thoroughly soaked over night in clean water. In the morning it was very soft and pliable, when it was cut of the required shape to allow it to be compressed into the cast iron form shown in Fig. 2. It may be necessary for the inexperienced mechanic to try compressing it first, in order to see just how to cut the leather, otherwise he may spoil the ring.

The hole through the middle should be a little smaller in diameter than the inside diameter of the form, so that when compressed, the leather will just stretch over it. Poor leather should never be used for hydraulic packings, for it will always be a source of trouble. The leather I used was of about $\frac{7}{32}''$ uniform thickness. The bottom of the mould formed in the cast iron block *e*, was a true circle $\frac{3}{4}''$ in diameter, while the follower *f* was $\frac{1}{4}''$ thick and rounded off at the end, a true circle. The leather, after being prepared, as described, was placed upon the form, the head of the bolt *g* was caught in a vise, the cap *d* was put in place, then, by slowly tightening the nut *h*, the leather assumed the shape of the form. After being thoroughly compressed, the leather was dried by a moderate heat, then removed from the form and the edges *m m* carefully pared, as shown at *j j*, in Fig. 3. After trimming, the packing was immersed in blood warm beef tallow, and when thoroughly soft the surface was wiped off and the packing placed in the recess prepared for it. The causes of failure in making tight hydraulic packings of leather are numerous. I will mention a few. The leather is generally poor and of uneven quality, when it ought to be of the best. Insufficient time is generally taken to soak the leather, consequently when it is compressed in the mould the grain is broken at or near *i*, in Fig. 3. The mould may be of improper shape as, for instance, the bend instead of being a true circle is made flat, having two corners which require the leather to be bent at nearly a right angle. This is almost sure to break the grain of the leather, which will soon rot by the water being forced into, and through it by the enormous pressure to which it is subjected.

Another cause of failure in this style of packing is that the packings are made too wide. I have seen them $1\frac{1}{4}''$ and $1\frac{3}{8}''$ wide, which is entirely unnecessary. When made too wide the leather is subjected to a much greater strain which breaks its grain, and the edges will pucker or form ridges, with which it will be very difficult if not impossible to make a tight joint. The edges *j j* are generally left square or rough, so that they cannot close upon the ram so as to be tight. I have found that upon a wheel press having a ram 9″ in diameter a packing $\frac{1}{4}''$

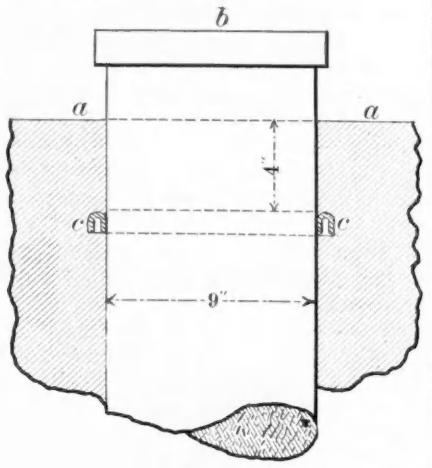


Fig. 1

wide, and having the edges pared at an angle of 35° to 40°, shown in Fig. 3, will do the best service. The packing is frequently put into a rough recess which has been cored in the casting for that purpose, and is almost sure to leak, as the rough surface will not make a tight joint with the leather. These recesses ought always to be bored out in order to get a good surface for the packing and insure its durability.

In some wheel presses the recess *c c*, Fig. 1, is located too near the face *a a*. In one case I have known the water to be forced through the casting, finally causing a fracture about one-third of the circumference. I made a new recess for the packing about 8″ from the face *a a*, and filled the old one with Babbitt metal, which made the press as good as new.

The new recess was cut by means of a boring bar made by turning off an old shaft coupling so as to fit the bore of the cylinder. A piece of shafting about six feet long was attached to the coupling, to which was fitted the gearing belonging to a cylinder boring machine. A hole was drilled through the hub of the coupling, and a tool was inserted, which was held from turning by a set screw, the tool being filed flat upon one side. The opposite end of the hole was tapped and a set screw inserted, so that by tightening it with a wrench the tool was fed forward.

This was a cheap rig, and performed its work admirably.

Hydraulic Riveting.

We have received the following letter from Ralph H. Tweddell in regard to his system of hydraulic riveting. In referring to the cut, *B* denotes a portable riveter for foundation rings and fire hole doors; *C*, *C*, portable riveter for smoke box tube plates; *D*, portable riveter for riveting steam domes and man hole mountings; *E*, hydraulic lift attached to steam crane; *F*, swing crane with walking pipes, conveying pressure to hydraulic lift and riveter.

I have read with considerable interest the extracts from the report of the Committee of Research in Boiler Construction and Improvement, given by you in your number of July 2, when describing a meeting of the Railway Master Mechanics. When I see that a report on different modes of riveting, prepared by a committee whose proceedings you consider to be of great practical interest, states that there are only three modes of riveting, "set riveting," "hand riveting," and "steam riveting," I can only conclude that a fourth system, known as "hydraulic riveting," has not been much benefited, so far as publicity is concerned, in having received the highest possible award at the Philadelphia Centennial Exhibition of 1876, this award having been granted to the sole makers of my system in America, Messrs. William Sellers & Co. of Philadelphia.

I do not wish to use other than the advertising columns of a scientific paper for that purpose; but I do not think I am open to this charge in referring your readers to a system of hydraulic riveting machinery, with which my name is connected, and which system would, I am sure, have received the fairest consideration from the Research Committee of Master Mechanics had they known of it.

I myself have as yet a pleasure in prospect—that of visiting your country—and I am quite sure, had I not been so fully engaged here, that by this time the hydraulic system would have been in even more universal use in the United States than it is now in Great Britain and on the European Continent.

When I mention that Messrs. Sellers & Co. have driven 5,000 ⅞″ rivets in 9½ hours with one machine, and that in this country I am closing 2,000 ½″ *rivets* for 6¾d. per hundred on wrought iron wagon frames; that I am riveting ship frames and reverse bars at 3s. per hundred rivets, 1″ diam., and also riveting up such heavy work as the keels of the S. S. "City of Rome" and "Servia," where the rivets are 1½″ diam. × 8¼″ long, through plates and bars of a total thickness of 6¾″, I think I can safely say that the system is not only firmly established, but applicable to all sorts and conditions of work. I can quite understand set riveting [which is, however, not new] giving better results than hand riveting, so far as the resistance of the rivet head is concerned—in the latter case, they are all more or less crystallized by the repeated blows; in the former, there is a steadier pressure—but I need not point out to you that, if this holds good in comparing "set" riveting with hand riveting, much more is the improvement obtained by the use of steady hydraulic pressure when compared with steam or hand, or even set riveting, which, after all means a series of blows, with only an intermediate buffer or shaping tool between the hammer and the rivets.

I enclose you a tracing, which you may possibly be able to reproduce, which shows what can be done in the way of riveting up a locomotive boiler on my system.

Many of these tools can be seen in Canada, and I trust some day in the United States.

I should add that my hydraulic system is not only applicable to riveting, but equally so to other machine tools. I would refer you to a paper read in Paris in 1879, by Mr. Marc Berrier Fontaine, one of the most eminent engineers of the French marine. This shows many of the advantages obtained, even at that time, and I may add that Mr. Henry Chapman, C. E., of Paris, is at present fitting up an entire private shipbuilding yard in France on my system, including punching and shearing machines also.

The advantage obtained by using hydraulic punching, shearing, flanging and other machines, in the manufacture of steel, was recently pointed out in a paper read before the Institution of Naval Architecture in London.

I cannot but think that a visit to any such railway shops as those of the London and Northwestern Railway Co., at Crewe, where Mr. Webb can finish a locomotive boiler off without manual riveting at all, or to the Great Western Railway shops at Swindon, where wrought iron wagon bodies are altogether riveted by hydraulic pressure, would soon convince any one that "*set*" riveting (while it may be better than hand or steam), is in its turn bound to give way to that done by hydraulic pressure.

RALPH H. TWEDDELL.

London, England.

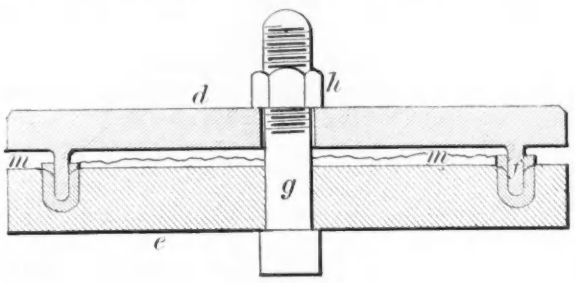


Fig. 2

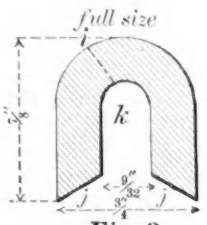
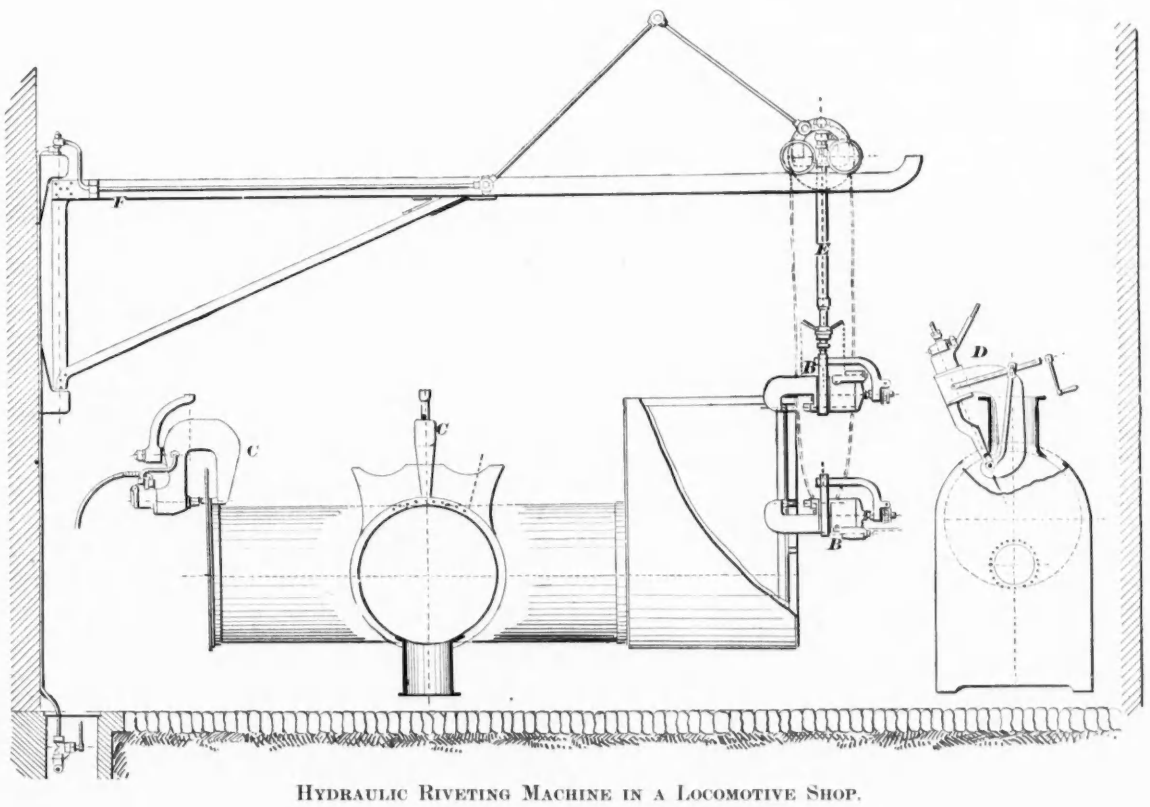


Fig. 3



HYDRAULIC RIVETING MACHINE IN A LOCOMOTIVE SHOP.

Self-Confidence.

Undoubtedly there is such a thing as overconfidence; that is, an individual may have more confidence in his ability than his knowledge of the subject will warrant; but by far the greatest trouble arises from a lack of self-confidence. While a man—especially a young man—should temper his views with modesty, he ought to, at the same time, have perfect confidence in himself. The lack of this quality comes mainly from a habit of leaning too much on others, and from never properly learning anything. There is not in a machine shop so uncomfortable an individual as the one who is constantly seen with a two-foot rule and a pair of callipers in his hand, and in a state of chronic uncertainty as to whether he is measuring right or not. What is true of the machine shop is as true, perhaps, of a hundred other places, but it seems particularly noticeable there. It is doubtful if a man has a moral right, when he shall have arrived at years of discretion, to lack confidence in his ability to do something.

Drilling out Broken Studs.

It is sometimes a matter of considerable trouble to extract the ends of studs that have broken off in the cylinder of a steam engine; especially when it is important that the size of the hole tapped be not enlarged. A good way to do this is to drill out the broken end to as near the size as possible, with a left hand ratchet brace and drill, and using kerosene oil for lubricating. The drill will in places break through the shell of the piece being drilled out, and the kerosene penetrating will loosen the contact. The friction of the left hand drill tends to turn the broken end out, and it will usually have loosened it by the time the drilling is concluded. Many ratchet braces may be readily converted from right to left by reversing the ratchet wheel. All ought to be so constructed as to be readily changed.

In the Pennsylvania Railroad shops at Altoona it takes 75 days, on the average, to repair an engine when it needs a new fire box. If it does not need a new fire box, 40 days will suffice to repair it.

Newly Incorporated Companies.

NEW YORK.

The Transportation Conduction Company, New York; John Hoey, F. E. Gilbert, J. Nelson Tappan, Hugh J. Hastings, J. R. McPherson, Jno. C. Lucas, Henry D. Moore, John W. Baker, I. C. Babcock and Lucius W. Maltby, incorporators; Capital, $50,000. To construct, maintain, operate, manufacture and lay lines of pipe for the purpose of transporting illuminating oils, elastic and volatile fluids.

Chester Electro-Conductor Company, New York; Albert W. Harris, Walter C. Harris, Cornelius V. Sidell and Van DeWater Smith, incorporators; Capital, $2,500,000. To construct and place electrical conductors in, through and over streets and highways and elsewhere, in the United States.

The W. H. Sweeney Manufacturing Company, New York; William H. Sweeney, James Hudd and Willis Stult, incorporators; Capital, $60,000. To manufacture and sell planished ware.

The Pneumatic Clock Company of New York; E. H. Denslow, Chas. C. Allen, Wm. R. Soutter, Simon Staul, S. L. Simpson, Rob't Edwards and R. T. Triplett, incorporators; Capital, $200,000. To manufacture, sell and lease pneumatic clocks, and to lay pipes for conducting power in connection therewith.

Acme Fire Escape Company, New York; H. R. Pinckney, Peter Humrod, M. J. Pinckney, B. O. Weil and Thos. J. Downing, incorporators; Capital, $200,000. To manufacture and sell fire extinguishers.

Fort Hamilton & Coney Island Railroad Company; James Hardie, Fred'k Eggers, Alfred Sully, Theo. Mangus, Wm. C. Herbert, Jr., J. R. O. Sherwood, M. E. Finnigan, Edw'd O'Connor, Andrew Jocham, G. Jetter, Jno. McLaughlin, W. C. Tredwell and Wm. Kowalski, directors; Capital $50,000. To construct, maintain and operate a railroad commencing at Fort Hamilton, in the town of New Utrecht, Kings County, thence north-easterly along Fort Hamilton and Atlantic Avenues; thence southeasterly through Atlantic and Bath Avenues, and Mill road across Coney Island Creek to foot of West 27th St., on Coney Island. Length of road, about four and two-third miles.

The Tallman Automatic Car Brake Company, New York; Stephen P. Tallman, Seymour Hait, E. A. Packer, E. M. Clymer, Chas. C. Keeler, David H. Jeffrey and Wm. E. Davenport, incorporators; Capital, $2,000,000. To manufacture, furnish, let, sell and maintain machinery to be used and operated upon railways and railway cars and carriages.

Fort Orange Paper Company, Castleton, Rensselaer Co.; Wm. Ware, Jno. J. Louth and Chas. H. Dilley, incorporators; Capital, $200,000. To manufacture and sell paper.

United States and South American Financial and Construction Company, New York; R. R. Pealer, Jno. H. B[illegible]ey, A. P. Berthond, Angelo Revello and John Gre[illegible], incorporators; Capital, $300,000. To construct public works, reservoirs, sewers, bridges, dams, wharves, dykes, etc., and to dredge and deepen channels, harbors, etc.

Charlotte and Lake View Railroad Company; J. Tillinghast, J. W. Whitney, H. H. Craig, Wm. Pincell, W. W. Cramsell, Charles Robinson, J. H. Rutte, G. H. Burrows, E. M. Upton, C. E. Fitch, C. H. Chapin, W. T. Simpson and Martin Beattie, Directors; Capital, $200,000. To construct, maintain and operate a railroad from the N. Y. C. & H. R. R. R., in the village of Charlotte, town of Greece, Monroe County, passing in a northeasterly direction to south shore of Lake Ontario, to or across Braddock's Bay inlet, and extending to such points on shore of Lake Ontario as may be necessary to reach the hotels or summer resorts.

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NEW YORK, AUGUST 20, 1881.

CONTENTS.

	PAGE.
The Pennsylvania Railroad Shops at Altoona	1, 2, 3
A New Registering Gauge	3
A Steam Engine Award	3
Letters From Practical Men—Machinists Who Can't Read Drawing—Devices for Gear Cutting—Breaking of Annealed Steel	3
New Slide Valve	4
The Two Forms of Threading Dies	4
Screw Cutting on the Engine Lathe. No. 2. By Frank H. Richards	4
Sketch of the Life and Work of W. S. Hudson	5
Cutting and Drilling Glass	5
A Big Day's Work	5
Extracts From Chordal's Letters	6
Shop Kinks. No. 12. By L. F. Lyne	6
Hydraulic Riveting	7
Self Confidence	7
Drilling Out Broken Studs	7
Elements in Railroad Economy	8
Dust Explosions	8
The Bursting of a Flue	8
The International Cotton Exposition	9
Questions and Answers	9
Manufactures	9
Newly Incorporated Companies	9
Machinists' and Engineers' Supplies	10
Iron and Metal Review	10

Elements in Railroad Economy.

There seems to be a misapprehension on the part of some railroad officials, from the fact that they do not properly consider the necessity and economy of making repairs in a thoroughly first-class manner.

The thought does not once appear to enter their heads that the railroads are repairing their own machinery, and if the work is not done well they run a serious risk of having an accident. We heard the complaint made in a railroad shop, not long since, that too much new work was being placed upon the engines. More of the old work might have been used and the cost of repairs reduced. This would seem to be a wrong view of economy, from the fact that the engines to which reference has been made were in want of a thorough overhauling. One of these engines went out on the road, where, after running a few trips, a rod strap was broken, the cause being the failure of a rod bolt. Another engine upon the same road broke a cross-head gib, which, getting caught in the end of the guides, became jammed so as to bend the guides and the piston rod. The cause in this case was the breaking of a cast iron gib, which was allowed to wear too thin. The managers of that road still insist upon using cast iron gibs as being the cheapest. The use of cast iron gibs upon the cross heads of passenger engines cannot be too strongly condemned as being highly dangerous and hazardous to the lives of passengers. The first cost is truly less than composition, but when a cast iron gib having no other support than its ends, becomes worn thin, it is sure to break, causing sufficient damage to furnish that engine at least with good composition.

Cast iron has been acknowledged for years to be unreliable where subjected to sudden and irregular strains, yet it has found its way into places upon the locomotive that ought to be filled by a much tougher and more reliable metal.

We have known side rods to be allowed to run upon locomotives after flaws were discovered in them, thereby running the risk of tearing off the side of the engine, breaking the crank pins, and killing the engineer. On one occasion an engineer upon starting a train from the station, noticed something was wrong, and, stepping from his engine, observed that one of the side rods was gone, while the other had assumed a shape resembling "a dog's hind leg." A search was instituted for the lost rod, which, after a fruitless search, was given up. Singular to state, the rod has never been found to this day. The Pennsylvania Railroad have an established rule to remove the side rods from passenger engines after they have been in constant use three years, and replace them with new ones. The fact is that many railroad companies run their machinery until it breaks down, then scientifically reflect upon what they make out to be an unavoidable accident, when, in reality, it was the result of carelessness and neglect. We have a case in mind where an engineer reported several spokes broken in the main driving wheel of a passenger engine.

The wheel was examined by the master mechanic, who declared it would run for some time yet. The engineer remonstrated, but all to no purpose, and one day the train was behind time, and a telegram announced that "No. 9" had broken a driving wheel and was helpless. The tire upon the broken wheel had burst, and all that was left of the wheel was the hub and two or three spokes. The tire had broken into five pieces, which, together with pieces of the wheels, had been hurled in all directions, completely divesting the right hand side of the engine of rods, wheel covers, pipes, and a portion of the cab, and barely grazing the head of the engineer. This was reported to the directors as an unavoidable accident, when, in reality, it was expected by the engineer every day for several months before it happened. Cases are on record of cracked driving wheels running for years without giving way, but they are exceptional. Where there appears to be danger it should be remedied at once, and thus spare the company the humiliation of being sharply criticised by the press and the public, besides being damaged far beyond the cost of necessary repairs, made in time.

Some master mechanics are continually altering the valves and nozzles of their engines, in order to make them steam better and work with greater economy, yet they neglect to insist upon taking proper care of the boilers. These are allowed to run for months, in some cases, without being washed out. Let a boiler become fouled by scale and mud, and enormous losses are sustained. For instance, the heat-conducting power of iron is about thirty times greater than compact scale, therefore, when the scale is allowed to attain any considerable thickness, a great deal of heat is lost.

This loss of heat, as will readily be seen, also reduces the capacity of a boiler.

As a rule, locomotive boilers have too many tubes located from $\frac{3}{8}''$ to $\frac{7}{16}''$ apart. Such boilers can use dirty or chemically impure water but a short time before the tubes become coated with scale, and the spaces intended for water become nearly, sometimes entirely, closed.

In one instance we observed the cleaning of a boiler that had been in use for five years, during which time the cylinder part had not been washed, because it was not accessible. The leg, however, had been washed about once every two months. When the tubes were removed, they were coated with scale about $\frac{3}{16}''$ to $\frac{1}{4}''$ thick, and there were two ash cart loads of dirt taken from the tubes and cylinder part of the boiler. In view of the fact that the lower rows of tubes, say up to the sixth row from the bottom, fill up with soot and dirt within a few days after the engine leaves the shop, the bottom four rows of tubes should be left out, and a good hand hole plate, $4'' \times 6''$, should be cut in the front flue sheet. A key should be used in place of a nut to tighten the plate, as a nut would soon corrode so as to be worthless, but a key can be readily loosened.

By leaving out the worthless tubes, greater space is allowed for dirt and scale to deposit without interfering with the heating surface, and, by putting a gallon or two of refined petroleum into the boiler occasionally, the tubes will be kept almost free from scale, which falls to the bottom in the shape of mud.

One master mechanic, we have noticed, now builds his boilers with $\frac{1}{2}''$ water space between the tubes. The result is a saving in fuel and a great reduction in the first cost of the boilers.

The matters we have referred to are too often considered by railroad officials of small importance, and they are too apt to insist upon the work of repairing being done as rapidly and cheaply as possible, even as if they were working for outside parties.

It pays to do work well. In other words, the best material should be used where subjected to great or sudden strains. A fine finish as well as all "gingerbread" work is unnecessary. This is subject to the discretion of the parties in charge, who should endeavor to strike the happy medium between true economy and the extravagance of neglect, which is too often classed in the category of genuine economy.

We present in this issue, a birdseye view of the extensive locomotive building and repairing shops of the Pennsylvania Railroad at Altoona, Pa., also a ground plan of the car shops in the same city. No description of these shops we could give in a single issue would convey any ample idea of them, but the few notes gathered by us during a short visit to the shops, and which appear on pages 1 and 2, will probably interest all our readers. The American Society of Mechanical Engineers, which holds a regular meeting at Altoona this week, has very properly set apart a half day for visiting these shops.

The Semi-Centennial Exhibition of the American Institute will open in this city September 14th. Those who intend exhibiting, and who have not already applied for space, should do so without delay, as there is no time to lose. Machinery will be received as early as August 22d, other goods September 5th. To facilitate the management, exhibits should be in position promptly by the opening day. It is not only annoying to the managers but to visitors as well, to have space reserved and exhibits delayed a week or two after the opening.

Dust Explosions.

The attention of scientists is again called to the danger arising from the explosive properties of various kinds of dust, by the recent accident at the brewery of George Ehret, in this city. It was an explosion of malt dust, and is said to have resulted in damage to the extent of $60,000, and would doubtless have been much more serious, notwithstanding the local fire apparatus, but for the timely and well directed efforts of the fire department. It seems reasonably established that under favorable atmospheric conditions the impalpable dust arising from various substances, not particularly inflammable themselves, becomes little less dangerous than gunpowder, responding to an accidental spark, often with disastrous results. Various safeguards have been proposed, the most sensible of which seems to be the removal of the dust by suitable ventilation.

It would seem that some experiments with a view to determine the explosive properties of the dust arising from the operations of various industrial processes, as well as the conditions under which explosions are most likely to occur, would be of considerable value in assisting to devise means to prevent their recurrence.

The Bursting of a Flue.

Notwithstanding the accidents that have already occurred to some of the excursion steamboats on the navigable waters of this country, there are still some more boats in use whose boilers would probably not pass a thorough inspection. We were with a party not long since upon an excursion boat. The boat was steaming along nicely, when the engine was slowed down and finally stopped. The anchor was dropped and the fires hauled. Upon inquiry, it was reported, after some hesitancy, that a flue had commenced to leak and it was thought best to haul the fires to prevent injury to the boiler. The passengers were sent home on another steamer, upon which we met the manager of the steamboat company. By close questioning him we learned that one of the small, short, vertical tubes in the boiler between the connections had burst. This was an accident which he considered of small importance, as tubes blew out every little while.

Tubes do not blow out of low pressure boilers without a good cause; and probably, if a careful inspector were allowed to examine the boiler in question, defects in other tubes would be found. The one that burst ought to have been taken out. The bursting or collapsing of a small tube is sometimes more dangerous than when the rupture is more extensive, and may be the immediate cause of serious consequences, as in the case of the Seawanhaka, by the destruction of which so many lives were lost.

By the simple bursting of a tube a small quantity of steam and water is allowed to enter the furnace, where the water is immediately decomposed, forming hydrogen gas. This ignites, and, forcing itself out from the furnace, spreads amongst the wood work, causing a rapid conflagration. Still greater care ought to be required by the Government inspector of steam vessels. His subordinates should be required to be extremely critical in their inspection of boilers, and should be held responsible for anything that may occur as a result of their neglect.

The International Cotton Exposition.

This exhibition, which will be formally opened at Atlanta, Ga., next October, seems thus early to be reasonably well assured of success. Since the inception of this enterprise its scope has been extended so as not only to include all textile fabrics and the machinery used in their manufacture, but

other products of the country as well; and finally yielding to a wide spread demand, the managers have decided to admit any or all industries, not only of this country but of the world. The plan of the main exhibition building is in the form of a cross of four equal arms, and is 720 feet long and 96 feet wide. Centrally located in this building will be the four large steam engines which furnish power for driving the machinery. It is intended that all the different processes through which the cotton passes from the field to the finished products in all their variety may be witnessed.

Blank applications for space are furnished, with the rules and regulations governing all exhibits printed thereon.

An entry fee of $25 is charged, which entitles the exhibitors to all the space required to properly display their exhibits, as well as free admission for themselves and assistants, and which is the only charge made.

Some of the large Eastern manufacturers, particularly of thread, will send their skilled operatives to regularly manufacture their goods during the continuance of the exhibition; while the manufacture of the coarsest and the finest textile fabrics will be simultaneously going on.

One of the objects of this exposition is to bring together from all sections those who are in any way interested in handling cotton—either in raising, selling or manufacturing—in the expectation that an exchange of sentiment will be mutually advantageous, by leading to a better understanding of the wants of all. Arrangements are being made for hearing addresses from representative men.

The railroads, not to be outdone, propose to fill two large buildings, devoted to the purpose, with specimens of minerals and woods gathered from the country through which they pass. The various railroads of the country have placed the price of excursion tickets at extremely low figures, which, together with the natural attractions of Atlanta in the fall and early winter, will doubtless insure a flattering attendance. Ample accommodations are to be provided for entertaining twenty to thirty thousand visitors daily, and the grounds are very finely located.

On page 3 of our last week's issue, the titles under the two steam pump engravings got reversed in the printing office. Where it read "steam end" it should have been "water end," and *Vice versa*

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) W. H. S., Albany, N. Y., writes: We have a compound engine, h. p. cylinder, 14″x16″; l. p. cylinder, 26″x16″; boiler heating surface ample. We calculate to run the engine 150 revolutions per minute, using steam at 90 pounds pressure. We are provided with an air pump, 6″ diameter by 12″ stroke, and a circulating pump of a capacity of 8,000 gallons per hour. We wish to know the least number of square feet of condensing surface we can depend on for a satisfactory vacuum. We propose to make our surface condenser of brass tubes, ⅝″ outside diameter, and to use the steam inside and water outside the tubes. Would a different style of air and circulating pump make any difference? What would be the difference with the steam on outside of tubes? *A.* The condensing surface should be proportioned to the amount of steam used, which would in turn depend on the point of cut-off. It is also proportioned to temperature and quantity of water circulated. We should, as we understand the conditions, make a condenser having 600 feet of cooling surface. Condensers are made with the water inside or outside of tubes, according to the views of the builder. When properly constructed and proportioned, they work satisfactorily either way. You do not describe your air pump, but there should be no difficulty with that. The particular kind of circulating pump is immaterial, so long as the water is supplied as wanted.

(2) W. D. A., Pittsburgh, Pa., writes: I had an argument with a shopmate of mine in regard to making a perfect square. He claims that it is an impossibility to make a square so perfect that with the aid of certain instruments, a slight defect in one or more of the four sides cannot be detected. I claim it is not. Which is correct? *A.* Your shopmate is right. While it is possible to make the piece square enough for all practical purposes, it is undoubtedly impossible to make it so absolutely perfect that an error cannot be detected, if the means employed are delicate enough. It might, however, call up a question between the truth of the piece and the instruments by which it was tried.

(3) B. C. S., Brockville, Canada, asks: Would there be an economy worth the trouble and expense of putting an outside pipe around an iron smoke stack, and exhausting the air down between the two, and force the heated air under the grate bars of a boiler furnace with an exhausting fan? I now use a fan blast, delivering cold air under the grates, for burning anthracite coal dust. In this case the additional power used to exhaust the hot air would be small. *A.* We should say no. The tendency would be to condense the ascending gases, thereby rendering the draft sluggish, which would more than overbalance the gain from the slightly heated air.

(4) E. H., Mountain River, N, J., writes: I have a circular cast iron dry-pan in sections. Each section has an inlet and an outlet. The inlet is connected to main steam pipe from boiler, the pressure upon which is 75 lbs. per square inch, and the outlets are connected to steam trap. What kind of a regulator shall I use, so that the pressure on pan shall not exceed 25 lbs.? *A.* Arrange your pipes, if they are not already so arranged, so that there shall be but one outlet from main steam pipe, and in the pipe leading from that put a reducing valve, sometimes called a pressure reducer. After you get beyond the reducer, you can branch off in as many directions as you choose. These reducers are so arranged that they can be regulated to reduce the steam to any required pressure. You will need a gauge on the pipe between the reducer and the pan, and if any serious results are likely to occur from increased pressure, there should be a safety valve also in this pipe. These reducers can be obtained from supply dealers.

(5) W. F. S., Camden, N. J., asks: Can you afford me any information through the columns of your paper, as to the safe, or bursting, pressure of wrought iron water or gas pipe? *A.* This can only be determined by actual test of each piece of pipe. Wrought iron pipe is made of different thicknesses, according to the pressure it has to hold. Ordinary pipe is made of such thickness (varying with the diameter) that it is supposed to hold with safety 150 pounds per square inch, and while some of it will doubtless hold much more, some of it is hardly safe at that pressure. The pipe is all tested at the manufactory, but mainly for the purpose of finding poor welds or pin holes, if there are any such. The pressure at which it is tested is from 100 to 200 pounds per square inch. Special pipe is manufactured to hold almost any pressure desired.

BUSINESS SPECIALS.

50 cts. a line for each insertion under this head.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Steam Engines Indicated and Examined. Power Measured. W. H. Odell, P. O. Box 274, Yonkers, N.Y.

Bound volumes for 1880 of the AMERICAN MACHINIST.—We can furnish Vol. 3 of the AMERICAN MACHINIST, containing the full 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. AMERICAN MACHINIST PUBLISHING CO., 69 Fulton Street, New York.

James W. See, Consulting Engineer, Hamilton, O.

"Paragon" Metallic Piston Rod Packing. See AMERICAN MACHINIST, July 16th, 1881. Write for prices. A. Wilkinson, Manayunk, Philadelphia, Pa.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Company, 96 Fulton Street, New York.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price, $2.00, Mailed by E. & F. N. Spon, 446 Broome St., New York City, on receipt of price.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

MANUFACTURES.

The Brush Electric Illuminating Co., of Albany N. Y., have orders from that city for three hundred lights.

The Gilliland Electric Manufacturing Company, of Indianapolis, recently shipped at one time 1,000 bells and 15 switch boards to Antwerp, Belgium.

The Tanite Company, manufacturers of the Tanite emery wheels and grinding machinery, at Stroudsburg, Pa., are largely increasing their facilities for manufacturing, so as to keep up with their orders. Their foreign trade is rapidly increasing.

The Washburn Iron Company, Worcester, Mass., are to commence the manufacture of steel rails in about two months.

The Deane Steam Pump Company, of Holyoke, Mass., have established warerooms for the sale of their pumps in Chicago, Ill.

The Baldwin Locomotive Works, of Philadelphia, are at work on a locomotive which it is expected will run at a speed of 80 miles an hour.

An extensive stove foundry is about to be erected at Nashville, Tenn., the citizens immediately subscribing one half the necessary capital.

The buildings of the celluloid works at Adams, Mass., will be ready in a few days. The workmen are to be brought from England.

Two new locomotives, of the Underhill pattern, are being built at the Boston & Albany Shops, at Springfield, Mass.

The Troy Globe Valve Company, of Troy, N. Y., have ordered a lot of special tools for the manufacture of their valves.

The village of East New York, on the outskirts of Brooklyn, N. Y., is moving for public or private water works to supply the town.

The Rhode Island Locomotive Works are building ten locomotives for the Atlantic and Pacific Railroad Company, having cylinders 20″ in diameter, with a stroke of 26″.

The first knitting mill in the United States that was run by power, is being demolished at Cohoes, N. Y. It was built in 1832, and was the beginning of a great industry.

The Grant Locomotive Works, Paterson, N. J., are constructing another Fontaine locomotive, which, it is thought, will be an improvement on the first one built.

W. Douglass & Son, boiler makers and boat builders, of Pittsburgh, Pa., are building new and extensive shops in which to carry on their business.

Willson and Hendrie, of Montague, Mich., are erecting a new iron foundry. This firm build stationary and marine engines and boilers, general and special mill machinery, etc.

The Brainard Milling Machine Company, of Hyde Park, Mass., have recently made an addition to their main building, by which their capacity for doing work will be materially increased.

The Pratt & Whitney Company, of Hartford, Conn, are employing a force of between 700 and 800 men. They have orders for nearly 300 engine lathes besides other tools.

The combination of a half dozen leading iron companies, of Missouri, has at length been effected. It is said the new company, known as the Missouri Iron Company, will practically control the iron interests of the state.

A Boston company is about to engage in the manufacture of the Quimby Electric Clock, which is designed to supersede the ordinary watchman's clock, now in such general use in manufacturing establishments.

The Westinghouse Machine Co., Pittsburgh, Pa., will hereafter be the sole manufacturers and lessees of the Alden Ore Crusher and Pulverizer. They expect to get into their new foundry within a week or two.

A. Aller, agent for Korting's Universal Injector, 109 Liberty St., New York City, is executing an order for five Korting injectors, each of which are to throw 5,000 gallons of water per hour. These are said to be the largest injectors ever made.

D. S. Hines and W. A. Perry, surviving partners of the late Henry R. Worthington, have formed a copartnership with Charles C. Worthington. The business of the Hydraulic Works will hereafter be continued by them under the old firm name of Henry R. Worthington.

The National Boiler Works, of Chicago, will, on the first of September, erect a brick addition, 60x120 feet, to their establishment, and add thereto a quantity of new and improved machinery, consisting of punches, planers, shears, etc., and employ twice the number of hands in their works.

The Phenixville Iron Company, Phenixville, Pa., are manufacturing eight wrought iron columns for the new bridge across the Hudson at Albany. The length of each column is 53 feet 3⅜ inches, and the eight segments, of which a column is composed, are 1 9-16 inches each in thickness, and are fastened together with 894 steel rivets.

D. Saunders' Sons, Yonkers, N. Y., have just shipped two pipe cutting and threading machines to Crane Bros. Manufacturing Co., Chicago, Ill., one 4-inch and the other 8, for their new pipe. They already have several of the same kind in use. They have also shipped to W. C. Allison & Co., Philadelphia, one 6 and one 8-inch machine.

O. L. Packard, Milwaukee, Wis., manufacturer, agent and dealer in iron and wood-working machinery, engines, boilers, &c., reports business lively. He is furnishing the Milwaukee Exposition Association with 500 feet of shafting also hangers, couplings and pulleys for the same. Another lot of shafting, hangers, &c., to Michigan parties. An outfit of engine, boiler and machinery, for a Cutler Works, whose building is now in course of erection, engine and boiler for three elevators. Has recently shipped an engine and centrifugal pump to a Tannery in Michigan, is also furnishing engine and boiler for a new Excelsior Works in this state and the same for a distillery. Mr. Packard is agent for Medart Patent wrought iron rim Pulleys, of which he is selling many.

The Rogers Locomotive Works, Paterson, N. J. are erecting an additional building to their works, 125 feet square and three stories high. The lower floor is to be used exclusively for drilling and fitting up locomotive frames while the upper floors are to be occupied by small tools. Two new vertical stationary engines are also being erected for the purpose of assisting the water wheels, which for some weeks past have been short of water, thereby reducing the capacity of the works. The engines referred to are 22″ x 22″, condensing, and intended to develop 75 to 80 H. P. each. About 1,800 men are employed about the works and the capacity is nearly one locomotive per day.

Newly Incorporated Companies.

ILLINOIS.

Morris, Rockford and Northern Railroad Company; principal office, Morris; Phillips C. Haynes, La Fayette Beach, Nathaniel McBride, Aaron G. Woodbury, Henry Burrell and John Sampson, incorporators; Capital, $100,000. To construct and operate a line of railroad from the village of Braceville, in the county of Grundy, running through the city of Morris, in said county, to the Chicago and Northwestern Railroad in the city of Rockford, county of Winnebago, and State of Illinois.

Southwestern Lumber Company, Elgin; M. H. Thompson, J. W. Ramstead and Henry Whelen, incorporators; Capital, $50,000. For the purchase, manufacture and sale of timber, lumber and other building material.

Chicago Car Roofing Company, Chicago; Frederick K. Bowes, John C. Fortiner and Joseph M. Rogan, incorporators; Capital, $100,000. To do a general galvanizing business; to manufacture and sell corrugated or plain sheet iron, galvanized or painted, to be applied to buildings, warehouses, railroad car roofs and sidings, bridges, and for general purposes. To manufacture and sell any material used in the construction of cars, also to manufacture and sell railroad cars, and repairs therefor.

Calumet Iron and Steel Company, Chicago; C. R. Cummings, W. B. Howard and J. M. Flowers, incorporators; Capital, $2,000,000. For the manufacture and sale of merchant bar, band and pig iron, spikes, nails and Siemens-Martin steel.

The Eagle Foundry of Chicago; Nathaniel H. Jones, Lloyd B. Fuller and John J. Walsh, incorporators: Capital, $6,000. To do a general foundry business in Chicago.

Union Bag Machine Company, Chicago; Edward P. Hafch, L. Muther and Owen T. Aldis, incorporators; Capital, $5,000. For the manufacture, buying and selling of machinery, tools, goods, wares and merchandise.

NEW YORK.

The Mexican, Oriental, Inter-Oceanic and International Railroad Company. Directors: Jay Gould, Russell Sage, Sidney Dillon, Norvin Green, John F. Dillon, Thos. W. Pearsall, Amos L. Hopkins, Thomas T. Eckert, Ulysses S. Grant, Grenville M. Dodge and Francis De Gress. Capital, $25,000,000. To construct, maintain and operate a railroad in Mexico, commencing at a point on the Rio Grande, between Laredo and Reynosa; thence south to San Fernando and Santander Jimenez, with branch road to Cuidad Victoria; also with branches to Matanzas and bar of Jesus Maria. The trunk line to continue from Santander Jimenez to the City of Mexico, and may continue from there to a point on the Pacific Coast.

American Heat, Light and Power Company, New York; Thos. M. Wheeler, E. Deming, W. W. Evans and Lloyd Perry, incorporators; Capital, $5,000,000. To manufacture, use and sell machines for heating and lighting purposes, and for generating heat, steam and gas.

The Pond Electric Signal Company, New York; Henry K. Batcheller, Hiram L. Tracey and Chas. N. Talbot, incorporators; Capital, $300,000. To manufacture, operate and sell apparatus for signaling by electricity.

American Palace Sleeping Car Company, New York; A. H. Cragin, C. S. Bushnell, Sheppard Homans, J. H. Parsons, H. E. Dillingham, and others, incorporators; Capital, $10,000,000. To manufacture, own, furnish, let and sell locomotive engines, cars, rolling stock and machinery, to be used or operated upon railways.

Tarrytown Fuel, Gas and Light Company, Greenburgh, Westchester Co.; G. Hilton Scribner, R. W. Van Pelt and C. D. Wyman, incorporators; Capital, $200,000. To manufacture and sell gas and electricity, to be used for heat, fuel, light, power and other purposes.

Coney Island Fuel, Gas and Light Company, Gravesend; G. Hilton Scribner, R. W. Van Pelt and G. D. Wyman, incorporators; Capital, $300,000. To manufacture and sell gas and electricity to be used for heat, fuel, light, power and other purposes.

The Fell Boiler Improvement Company, New York; Edw'd S. Sanford, Thos. M. Fell and Luke Harrington, incorporators; Capital $1,500,000. To make, use and sell steam boiler attachments under letters patent issued to Thomas M. Fell.

New York Live Stock Express Company, New York; Stephen P. Tallman, Seymour Hait, D. H. Jeffery, Chas. C. Keeler, John Tilton, Benj. Odio, Felipe Perozo, A. C. Gonzalez and Nestor Ponce de Leon, incorporators; Capital, $2,000,000. To manufacture, furnish, let, sell and maintain railway cars for the transportation of live stock.

NEW JERSEY.

Peberdy Latch Needle Company, Camden: Samuel Peberdy, Jacob S. Duvall, William S. Dowdy and others, incorporators; Capital, $100,000. To manufacture and sell needles for knitting machines.

Lake Erie and Ohio River Construction Company, Bloomfield, N. J., and New York City; Elisha B. Sackett, George P. Valentine, C. A. Parsons, and others, incorporators; Capital, $1,500,000. To build, construct and equip railroads in the States of Illinois, Missouri, Indiana, Iowa, Kentucky and Ohio.

Carter American Tanning Company, Newark; Joel Carter, James L. Baldwin, Levi Dederich, and others, incorporators; Capital, $100,000. To manufacture and sell leather, and the dealing in hides, etc.

Clark Insulated Wire Company, Elizabeth, N. J., and Boston, Mass.; Henry A. Clark, William L. Lovell, Charles W. Holden, and others, incorporators; Capital, $500,000. To manufacture and sell insulated wire and cables for electrical purposes.

United States and European Stone, Marble and Tile Company, Camden; James H. Thorp, D. Garrison, George F. Currie, and others, incorporators; Capital, $500,000. To manufacture and sell artificial stone or building blocks, tile, marble table tops, etc.

Machinists' and Engineers' Supplies.

NEW YORK, August 4, 1881.

Trade is opening early for the fall season. The demand is very gratifying, and manufacturers are very busy. The Brown & Sharpe Manufacturing Co., and Darling, Brown & Sharpe, Providence, R. I., have a new pocket catalogue and price lists under date of August 1, 1881. It shows some changes in prices, all being in the direction of an advance. The catalogue contains 109 pages, and illustrates most of the machines and tools described. It will be sent by mail upon application. Their patent epicycloidal cutters, for the teeth of gear wheels, just brought out, will cut gears which are perfectly interchangeable. They are sharpened upon the face without changing their form, the same as involute cutters. A center line is marked upon two teeth, for the purpose of placing the cutter central with the work spindle. These cutters are new, and will undoubtedly become popular.

R. W. Rexford (successor to L. B. Eaton and Rexford), Philadelphia, has issued a new 104 page illustrated catalogue and price list of tools and machinists' supplies. It embraces goods of leading manufacturers, and presents a very good selection.

The Ashland Emery Co., Perth Amboy, N. J., have issued the following circular:

"For some time past this company has felt assured that the means adopted in Europe for the manufacture of emery had, in many respects, an advantage over the method adopted here; and a late visit there confirmed us in this opinion. We therefore at once set to work to acquire a similar plant and have already received a part, whilst the remainder is now on the way to this country. But it will probably be two months ere we can offer consumers emery made by our new method; meantime we desire to acquaint our friends with what we are doing, as we confidently expect it will be to their interest to delay making any contracts or even large purchases until they see what advantages we can offer. On our part we promise not to delay making known our terms longer than we can possibly avoid."

Iron and Metal Review.

NEW YORK, August 4, 1881.

The improvement in the pig iron market, noted in our last issue, continues, so that renewed activity is apparent in almost all branches of the iron trade. The demand has perceptibly increased, and contracts are willingly made upon present values, which are unchanged since our last report. We quote: No. 1 X Foundry, $24; No 2 X Foundry, $22, and Grey Forge, $20. Scotch Pig has not improved since last reported, and most of the sales made are for the retail trade. Eglinton sells at $21; Cambroe, $22.50; Coltness at $23.50 to $24, and Gartsherrie at $23 to $23.50; Glengarnock, $22.50 to $23. The rail market continues brisk. Iron rails sell at $48 to $50, and steel rails $58 to $60 at mill. No. 1 wrought scrap is held at $30 from yard. Ingot Copper is selling in small lots at 16¼c. to 16⅜c.; pig tin is strong at 21c. for Straits, 20⅜c. for Australian, and 20¼c. for Billiton. Common Lead is steady at 4¾c. to 5c., and refined at 5⅛c., to 5¼c. Western Spelter is firm at 5c. to 5⅛c.: Silesian is in little demand. Sheet Zinc, 7c. Antimony, 14½c.

WANTED

Wanted—Pattern Makers.—Twenty Pattern Makers wanted at once. Those accustomed to work on brass and iron fittings preferred. Good wages and permanent employment given. Apply in person or by mail to The Joel Hayden Brass Co., Lorain, Ohio.

Wanted immediately.—A Foreman Boiler Maker capable of managing a boiler shop with about 100 men. Send good references with application to Frick & Co., Waynesboro, Franklin Co., Pa.

Planer hand of fifteen years (15) experience in handling the heaviest kind of work, desires to change his location. Address, Box 4, care of the AMERICAN MACHINIST.

Wanted.—A mechanical engineer at present holding the position of mechanical supt. with one of the largest firms in the U. S. desires a re-engagement in a similar capacity, or would take charge of a shop in which he could eventually take an interest. Can present first-class references. Address, Box 10, AMERICAN MACHINIST.

Wanted—Position, in this city, to take charge of a small stationary engine, or position as vise hand, by a competent man. Address, W., P. O. Box 895, N. Y. City.

Mechanical draughtsman, used to general work, and able to design, desires engagement. Address, H. H., Box 9, AMERICAN MACHINIST.

NEW ENGLAND
MANUFACTURERS'
GREAT FAIR,
To Open August 18, 1881.
APPLICANTS FOR SPACE
are respectfully requestd to reduce as much as possible the amount applied for in order that Exhibitors who have not specified their requirements may not have their applications for space rejected.
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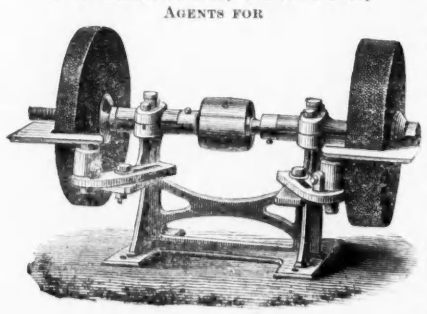

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The Hewes & Phillips Iron Works,
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1—100 H.P. Automatic Cut-off Engine, Cylinder 17 in. x 42 in. Second-hand.
1—Pair 12½ in. x 17 in. Engines, coupled, 100 H. P. capacity, Throttle Gov. Second-hand.
2—10 in. x 16 in. High Speed Allen Engines, 57 H. P. each. New.
1—11 in. x 16 in. High Speed Allen Engine, 70 H.P. New.
2—6 in. x 12 in. Engines, 15 H. P. capacity each, Pickering Gov. New.
1—9 in. x 12 in. Engine, 20 H.P. capacity, Judson Gov.
4—9 in. stroke Shaping Machines.
1—14 in. x 15 in. Steam Air Compresser. New.
1—Diamond Band Stone Saw. New.

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FRICTION CLUTCH PULLEYS
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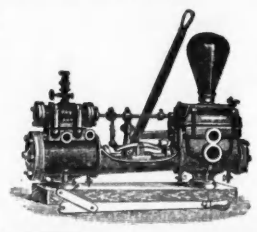
JAS. HUNTER & SON, North Adams, Mass.

Knowles' Improved Steam Pumps,



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Steam Pumps for Every Possible Service.
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Office, 101 Chambers Street, N. Y. | Full Weight Hand-Cut Files. | Manufactory, PATERSON, N. J.
The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

THE SINGER MANUFACTURING CO.
Messrs. KEARNEY & FOOT, Elizabethport, N. J., July 9th, 1877.
Dear Sirs:—We have for the past ten years used the Files of your manufacture, and during that time we have never had any fault to find with them. We can safely affirm that for evenness of temper, sharpness of cut, accuracy of shape and all other qualities which go to make up a perfect File, they are equal, and in some respects superior, to the best English-made Files. Very Truly, WM. H. INSLEE, Contractor.
Messrs. KEARNEY & FOOT, Elizabethport, N. J., May 3rd, 1877.
Gentlemen:—We have been using your Files, both new and re-cut, for several years, and take pleasure in saying that we have found them a very superior article.
HANS REISE, Contractor, with The Singer M'f'g Co.
We print on card board 10 x 12 in. "Instructions on the use of Files," which are intended for shop use. These instructions with our "Illustrated Catalogue of Files" we mail on receipt of 27 cents postage. To customers we mail a complete set free of charge. KEARNEY & FOOT.

The Cameron Mining Pump,
Designed for use in Gold, Silver, Coal and Iron Mines. Also for general Manufacturing and Fire purposes.
Pumps furnished with movable linings in iron, composition or Phosphor Bronze.
THE A. S. CAMERON STEAM PUMP WORKS,
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LEHIGH VALLEY EMERY WHEEL CO.
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Manufacturers of Emery and Corundum Wheels and Grinding Machinery.
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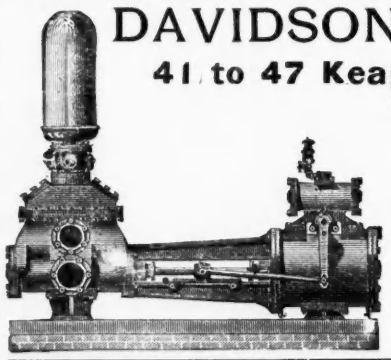
DAVIDSON STEAM PUMP CO.
41 to 47 Keap Street, Brooklyn, N. Y.
MANUFACTURERS OF
THE M. T. DAVIDSON
Improved Steam Pump.
Warranted the Best Pump Made for all Situations.



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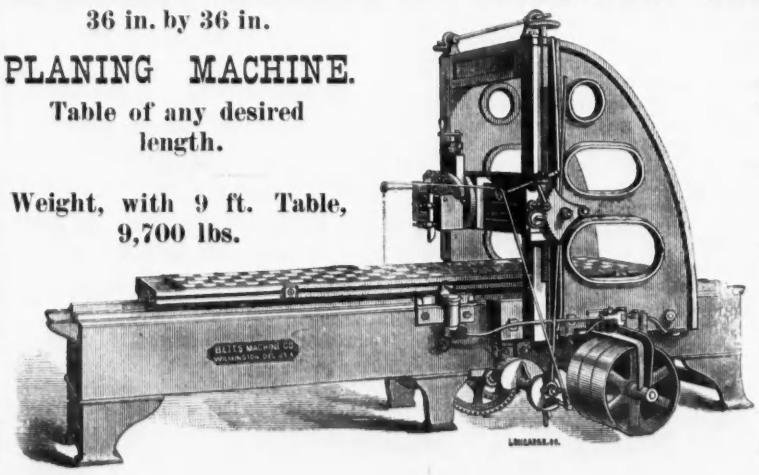
THE BACKUS WATER MOTOR CO., Newark, N. J., or 323 Broadway, New York.

NOISELESS ROTARY FANS
These fans can be fastened to ceiling or side wall, and driven by a round belt direct from a Backus Water Motor, Steam Engine or other power. Blades can be covered with paper muslin to suit the taste in color. By changing angle of Blade amount of air can be regulated. Two or more fans can be connected on ceiling. Shaft of fan runs in metaline journals, and requires no oiling, a consideration where put up in dining rooms over tables. Price, $5 each

BETTS MACHINE CO., WILMINGTON, DEL.
MAKERS OF
MACHINISTS' TOOLS,
STANDARD GAUGES,
MEASURING MACHINES and ADJUSTABLE REAMERS.
36 in. by 36 in.
PLANING MACHINE.
Table of any desired length.
Weight, with 9 ft. Table, 9,700 lbs.



Heavy Planers —A— Specialty
Any size, from 24 in. Square to 10 ft. Square